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OBSERVATIONS ON OWLS, WITH PARTICULAR REGARD TO THEIR FEEDING HABITS.

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THE following notes, from observations on the short-eared owl, *Asio acciptrinus* Pall., and the long-eared owl, *A. wilsonianus* Less., present some results from the examination of a considerable number of food pellets of these birds. These data may prove of interest from three points of view: (1) the kind of food eaten by these owls; (2) the relation of the amount of food found in the pellets beneath a roosting place to the total amount of food consumed; and (3) the comparative numerical abundance of small mammals in the vicinity, as deduced from their remains in the pellets.

At Christmas, 1898, four long-eared owls were found roosting in an arbor vitæ tree on my father's place, "Ardrossan," near West Chester, Penn. Before coming to this tree they had roosted in a small outleaved beech, until driven away by gunners. These owls were under my daily observation from Dec. 25, 1898, to Feb. 22, 1899. The tree on which they roosted is a large one, nearly forty feet in height, without especially dense foliage, situated between a house and a stable, about a dozen feet from either. Close to it passed many times a day people

and carriages, without having the effect of frightening the birds; and they showed no concern when I collected the food pellets from the ground beneath them. In the coldest part of the winter the owls regularly faced the east, and at one time, when four roosted together, three of them roosted near the center of the tree, one near the top, and each occupied regularly a particular branch.

About thirty feet to the southeast of the house is a magnificent Norway spruce, the roosting place of a short-eared owl. I first observed this bird on February 2, and kept it under regular observation from February 26 to March 26, except for a lapse of a few days between March 8 and 14. For a part of this time one of the long-eared owls, after leaving the arbor vitæ tree, roosted in this Norway spruce also.

These two trees were the only regular roosting places of owls in the neighborhood at this time, though there were a number of evergreen trees in the vicinity which were casual feeding perches, under which I found pellets.

My observations were of the following nature: Each day the number of owls were counted on the two roosts, and at regular intervals (usually each Sunday) all pellets were collected from the ground beneath each roost. These pellets were carefully examined, the number and kind of animal remains in them noted, and so the daily food average per owl computed. Here I wish to thank my friend Mr. Witmer Stone, curator at the Philadelphia Academy of Natural Sciences, for his assistance in determining the species of mammals.

First, a few notes as to the construction of the food pellets. It is well known that owls, as a rule, swallow their prey whole, that the food remains in the stomach until all digestible substances are extracted and passed into the small intestine, and that finally the remaining mass of undigested substances (bones with hair or feathers, hard parts of insects, etc.) is disgorged as a pellet (bolus). The pellets are more or less ovoid in form, and when freshly disgorged covered with a slimy mucus. Each pellet, of the two species of owls studied, usually contains the remains of only one food individual (*i.e.*, one mouse or one bird); about one in twenty contains two individuals; rarely

are more than two present in the same pellet, and pellets of this nature are considerably longer than usual, though of the ordinary diameter. The pellet, when the object eaten is a mammal or bird, is composed of a tightly welded mass of bones and hairs, or feathers. In the stomach of the owl the food mass must be subjected to a vigorous churning process, for only such a process could serve to explain the close welding of the materials in the ejected pellet. In a pellet there are no empty spaces, but the hairs or feathers fill tightly all the spaces between the bones, and are jammed into all grooves and foramina of the latter, the pellet, when fresh, being so compact that it cannot be roughly torn apart without breaking the bones contained in it. The skulls of mice are usually found crushed in the occipital region (the weakest portion), usually more or less intact anterior to the frontal; out of 570 skulls of the meadow mouse taken by me from pellets, only some fifty had the occipital region uninjured and attached to the rest of the skull; when several mice are contained in the same pellet, the state of preservation of the skulls is better than usual. It is truly remarkable how the hair is worked, by the churning process of the owl's stomach, into all cavities of the skull. There is always a tight wedge of hair in the preorbital foramen, in the foramen lacerum, in the ear and nasal cavities, as well as in smaller apertures. When the occipital region of the skull is crushed, the cranial cavity contains a tight wad of hair; and in a few skulls which remained intact the whole cranial cavity was densely packed with hair which had been forced through the foramen magnum! The lower jaws are usually well preserved (though their angular and coronary processes are frequently broken), and teeth are well preserved. Of the other bones of the mouse's skeleton contained in a pellet, it is strange that the slender and delicate ulnæ and radii are usually intact; the proximal end of the humerus is usually dislocated; the femora, tibiæ, ilia, vertebræ, and small bones of the hand and foot are usually uninjured, while the ribs, scapulæ, and fibulæ are usually broken. The less strongly built skulls of shrews and birds are considerably more crushed. As MacGillivray noted in 1836, the linings of birds' gizzards are disgorged intact

in the pellets. As far as I can determine, the gastric juices of the owls have no noticeable action upon bones.[1]

I.

The following tables represent the food eaten by the owls under my observation. Table I is for the long-eared owls on the arbor vitæ tree; Table II for the long-eared and the short-eared owl on the Norway spruce. For each table the first

TABLE I. ARBOR VITÆ TREE.

DATE OF COLLECTION	NUMBER OF OWLS ON THE TREE	CONTENTS OF PELLETS	DAILY FOOD AVERAGE
	Dec. 25, 4		
	" 26, 4		
	" 27, 4		
	" 28, 4		
	" 29, 4		
	" 30, 4	1 Finch	
	" 31, 4	1 Blarina	
Jan. 8	Jan. 1, 4	1 *Micr. pinet.*	
	" 2, 4	139 *Micr. penn.*	
	" 3, 4	14 *Micr. undet.*	
	" 4, 4		
	" 5, 4		
	" 6, 4		
	" 7, 4		
	" 8, 4		
	Jan. 9, 4		
	" 10, 4		
	" 11, 4	1 Peromyscus	
Jan. 15	" 12, 4*	1 *Micr. pinet.*	1.6
	" 13, 4	43 *Micr. penn.*	
	" 14, 4		
	" 15, 4		

[1] The pellets of hawks (I am familiar with those only of *Falco sparverius*) are very different from those of owls. The pellets of the sparrow hawk are smaller, elongate, usually pointed at the ends, and more or less spirally twisted. In them there is frequently no trace of bones, and when the latter are present they are usually in a fragmentary condition. A hawk tears its prey to pieces in the process of eating, which would account for the breaking of the bones.

TABLE I. — *Continued.*

DATE OF COLLECTION	NUMBER OF OWLS ON THE TREE	CONTENTS OF PELLETS	DAILY FOOD AVERAGE
Jan. 22	Jan. 16, 4 " 17, 4 " 18, 4 " 19, 4 " 20, 5 " 21, 4 " 22, 5	2 *Micr. pinet.* 41 *Micr. penn.* 4 *Micr. undet.*	1.57
Jan. 29	Jan. 23, 5 " 24, 0 " 25, 4 " 26, 4 " 27, 4 " 28, 4 " 29, 4	1 Mus. 47 *Micr. penn.*	1.92
Feb. 5	Jan. 30, 4 " 31, 0 Feb. 1, 1 " 2, 0 " 3, 3 " 4, 2 " 5, 2	1 *Passer domesticus* 1 *Micr. pinet.* 25 *Micr. penn.*	2.16
Feb. 26	Feb. 6, 2 " 7, 1 " 8, 2 " 9, 2 " 10, 1 " 11, 2 " 12, 2 " 13, 1 " 14, 0 " 15, 0 " 16, 0 " 17, 0 " 18, 0 " 19, 0 " 20, 0 " 21, 0 " 22, 1	1 Peromyscus 1 *Micr. pinet.* 24 *Micr. penn.*	1.86

TABLE II. NORWAY SPRUCE TREE.

DATE OF COLLECTION	NUMBER OF OWLS ON THE TREE	CONTENTS OF PELLETS	DAILY FOOD AVERAGE
Feb. 26	Feb. 2, 5 *wils.*, 1 *acc.* " 3, 1 *acc.* " 19, 1 *wils.* " 24, 1 *wils.* " 26, 1 *wils.*	50 *Micr. penn.*	
Mar. 5	Feb. 27, 1 *wils.* " 28, 1 *wils.* Mar. 1, 1 *wils.* " 2, 1 *wils.* " 3, 1 *acc.* " 4, ? " 5, 1 *acc.*, 1 *wils.*	1 *Blar. parva* 1 Zapus 1 Cambarus 1 Finch (?) 27 *Micr. penn.*	2.42 ?
Mar. 14	Mar. 6, 1 *acc.*, 1 *wils.* " 7, 1 *acc.* " 8, 0 ? " 14, 1 *acc.*	1 *Passer domesticus* 1 *Melospiza fasciata* 1 *Blar. parva* 18 *Micr. penn.*	
Mar. 19	Mar. 15, 1 *acc.* " 16, 1 *acc.* " 17, 1 *acc.* " 18, 1 *acc.* " 19, 1 *acc.*	1 *Melospiza fasciata* 6 *Micr. penn.*	1.2
Mar. 26	Mar. 20, ? " 21, 1 *acc.* " 22, 1 *acc.* " 23, 1 *acc.* " 24, 1 *acc.* " 25, 1 *acc.* " 26, 1 *acc.*	1 Bird 4 *Micr. penn.*	.57

vertical column gives the date of collection of pellets; the second, the number of owls on the tree each day; the third, the contents of the pellets; the fourth, the number of small mammals (mice and shrews) eaten by each owl daily. This number was ascertained at each period of collection of pellets, by dividing the total number of mammals by the number of days when owls were present on the tree, and dividing the

resultant number by the total number of owls divided by the number of days. The second vertical column of Table II shows which of the two species of owls were present each day, by the abbreviations "acc." and "wils." for *Asio acciptrinus* and *A. wilsonianus* respectively. In the third vertical column of both tables "Micr. penn." stands for *Microtus pennsylvanicus* (meadow mouse); "Micr. pinet.," for *M. pinetorum* (pine mouse); "Micr. undet.," for species of Microtus which could not be determined owing to the poor state of preservation of the remains; "Mus," for *Mus musculus* (house mouse); "Peromyscus," for *P. leucopus* (white-footed mouse); "Zapus," for *Z. hudsonius* (jumping mouse); "Blar. brev.," for *Blarina brevicauda;* and "Blar. parva," for *B. parva.*

For each owl on the arbor vitæ tree the daily average of small mammals, in the different weeks, varied from 1.57 to 2.16. The collection of pellets made on January 8 had been accumulating for an undetermined period antecedent to that date. It is interesting to note that in the especially cold and stormy month of February the amount of food obtained by the owls was up to the average. The contents of these pellets may be summarized: 2 birds, 1 Blarina, 2 *Peromyscus leucopus*, 1 *Mus musculus*, 6 *Microtus pinetorum*, 319 *M. pennsylvanicus*, and 18 undetermined individuals of Microtus.

For the owls on the Norway spruce the daily average of small mammals per owl was 1.2 one week, and only .57 another; for the week given in the second transverse column of this table it would be 2.42, provided two owls were present each day, which I have good reasons to suppose to be the case, though I did not see the two each day. I could not determine how long the pellets had been accumulating which are given in the first transverse column. To summarize the pellets of this table: 1 Cambarus, 5 birds, 2 *Blarina parva*, 1 *Zapus hudsonius*, and 105 *Microtus pennsylvanicus*. On the Norway spruce the short-eared owl was the regular resident, the long-eared owl more irregular in occurrence; and it is probably due to the differences in the feeding habits of the former that the bones in the pellets were more badly broken than is the case with long-eared owls, and that the daily food average was smaller.

Within a radius of an eighth of a mile of these two trees there are a number of evergreen trees, under which I found at various times considerable numbers of pellets; since these proved to be not roosting but merely casual feeding perches, and since I found no other owls roosting in the vicinity, it would seem very probable that these pellets, or most of them, were produced by the owls observed by me. These pellets contained the remains of 5 small birds (including Regulus, Junco, Certhia), 3 *Blarina brevicauda*, 3 *B. parva*, 1 Blarina, undetermined, 2 *Zapus hudsonius*, 3 *Peromyscus leucopus*, 1 *Microtus pinetorum*, 139 *Microtus pennsylvanicus*, and 4 undetermined individuals of Microtus. Pellets found under trees which are not day roosts would necessarily contain the remains of animals eaten by the owls in the early evening, before they returned to their roost.

II.

The very fact that pellets are found beneath trees which are merely feeding perches, as they have been termed by me, proves that the pellets beneath a roost do not represent all produced by owls. How great a proportion of all the food consumed is contained in the roost pellets cannot be determined by field observation alone, since it is impracticable to follow and observe owls during their nocturnal wanderings. To determine how much food is eaten by owls, and how many pellets are disgorged away from their roosting places, I have compared my data with those given by Dr. A. K. Fisher in his very able and thorough work, "The Hawks and Owls of the United States in their Relation to Agriculture" (*U. S. Dept. Agric. Bulletin*, No. 3, 1893). Dr. Fisher tabulates the results of the examination of several thousand stomachs of our rapacious birds. To be sure, the number of objects found in an owl's stomach do not necessarily represent all eaten by that owl in the course of a day. But since Fisher's tables show per bird a somewhat higher average of food contents than do mine on pellets, his figures would approximate closer to the total food consumption per owl, and on this account the comparison of the two sets of data may be of interest.

Fisher gives the results of examination of the contents of 92 stomachs of *Asio wilsonianus*, and of 87 stomachs of *A. acciptrinus* (when we eliminate those stomachs which were found empty, and which probably were of birds shot in the daytime). I have carefully computed from Fisher's tables for these two species of owls the exact number of food objects in detail per stomach, and the results may thus be compared with my data, counting in only mice, shrews, and small birds.

A. wilsonianus { (Fisher) mice, shrews, 1.52 ; birds, .26.
(mihi) " " 1.57, 2.16 ; birds, .08.

A. acciptrinus { (Fisher) " " 1.78 ; birds, .22.
(mihi) " " .57, 1.2 ; birds, .14, .2.

This comparison of the two sets of data would show that the long-eared owl probably does the greater part of its digestion, and disgorges most of its pellets on its roost. But the short-eared owl, since here there is a marked discrepancy between the figures of Fisher and myself, would appear to disgorge a smaller proportion of its pellets at its roost, and a considerable number at casual feeding perches; this is probably referable to the more crepuscular mode of life of the short-eared owl, which leaves its roost earlier in the evening, and returns to its roost later in the morning. The food of the short-eared owl is more diversified than that of the other species, probably due to its covering more varied feeding grounds in its hunts.

III.

Finally, as to the numerical abundance of our mice and shrews, as deduced from the relative abundance of their remains in owl pellets. It must be kept in mind that owls hunt for their food mainly on open meadow and marsh land, less in thick woodland. Their hunting is also mainly done by night. Accordingly, woodland and diurnal mammals would be less frequently destroyed by them than would nocturnal mammals of the more open districts. But the following figures would give a fair comparison of the numerical abundance of such small nocturnal mammals as are found at night in the hunting areas

of the long-eared and short-eared owls. To the data of contents of pellets from the Norway spruce, and arbor vitæ trees, and of feeding perches within a radius of an eighth of a mile of them, I will add the contents of pellets found at other localities in the course of this season of observation, and we find the following numbers of individuals of different species of mice and shrews: *Microtus pennsylvanicus*, 570; *M. pinetorum*, 7; *Microtus* (undetermined, but probably *pennsylvanicus*), 26; *Zapus hudsonius*, 3; *Peromyscus leucopus*, 5; *Mus musculus*, 1; *Blarina parva*, 10; *B. brevicauda*, 6, and *Scalops* (?), 1. Thus *Microtus pennsylvanicus* would appear to be the most abundant mouse, and *Blarina parva* the commonest shrew.

In conclusion, it may be noted that these data add further support to the well-proven results of ornithologists, that our local owls (with the possible exception of the great-horned owl) are of the greatest benefit to the agriculturist. Our three commonest local owls, the screech, long-eared, and short-eared (as well as the rarer acadian and barn owl), are indefatigable destroyers of mice and insects. But since this is the case, and since the group of the owls is one of great interest to the naturalist, it is to be hoped that future students of their dietary habits will avoid studying their stomachs for this purpose, and in order not to destroy them examine their food pellets instead.

THE WINGS OF INSECTS.

J. H. COMSTOCK AND J. G. NEEDHAM.

CHAPTER IV (*Concluded*).

The Specialization of Wings by Addition.

V. THE TRACHEATION OF THE WINGS OF ORTHOPTERA.

THE study of the tracheation of wings of orthopterous nymphs was undertaken merely for the purpose of determining the homologies of the wing-veins in this order; but some of the results attained have a much wider bearing, giving a hint as to the position of this order in the class Insecta. For this reason, after setting forth the conclusions regarding the homologies of the tracheæ of the wings, a brief discussion of the taxonomic bearing of some of these conclusions will be given.

The Homologies of the Principal Tracheæ of the Wings of Orthoptera. — In this investigation representatives of the Blattidæ, Acrididæ, Locustidæ, and Gryllidæ have been examined; no living nymphs of members of the Mantidæ nor of winged Phasmidæ were studied. It is not probable, however, that these will present serious difficulties.

The most uniform characteristic of the wings of the four families studied is the structure of the anal area of the hind wings. For this reason we will begin our description of the tracheation of the wings with this area and proceed cephalad.

In the Orthoptera the anal area of the hind wings is broadly expanded and fanlike in form. The first anal trachea is simple (Figs. 74–78 *A*); the second and third anal tracheæ coalesce for a distance and then separate into several tracheæ, each of which traverses a convex vein of the fanlike portion of the wing. Sometimes, as in the wing of an Acridid, represented by Fig. 75, the common trunk of these two tracheæ divides into two large trunks, which probably correspond to the second and third

anal tracheæ respectively; but in most cases this division is not clearly indicated.

In many of the saltatorial Orthoptera the anal area of the hind wings bears a striking resemblance to the wings of Ephemerids, there being a regular alternation of convex and concave veins. In these cases the concave veins are evidently a later development than the convex veins. The increase in the number of the branches of the anal tracheæ takes place at the cau-

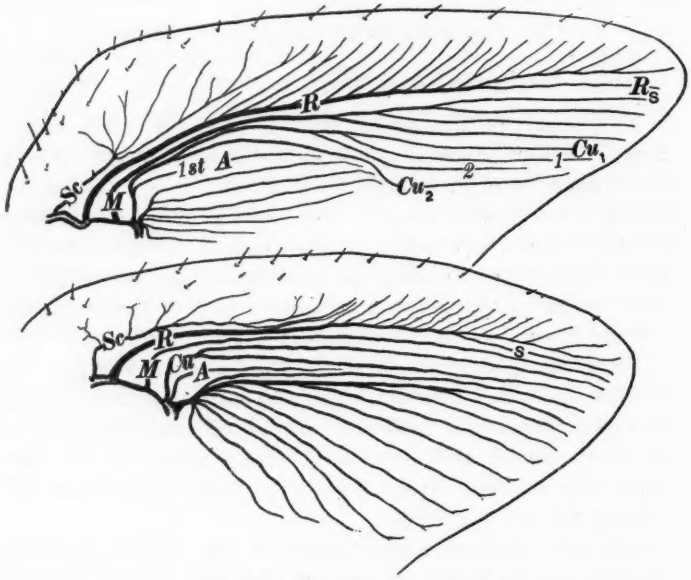


FIG. 74. — Wings of a nymph of a cockroach.

dal end of the series, and about each added trachea a convex vein is developed. It is only after the space between two of these convex veins becomes wide enough to admit of a fold in the wing that a concave vein is developed, and this development takes place in the same manner as in the Ephemerida. In some cases, as in the hind wings of Scudderia (Fig. 77), a tertiary set of anal veins is developed; these extend only a short distance from the margin of the wing, and increase the resemblance of this area to an Ephemerid wing.

The cubital trachea of the hind wings varies greatly in form, even within the limits of a single family. In the Acrididæ it is sometimes reduced to an unbranched condition (Fig. 75 *Cu*); in all of the Locustidæ known to us it retains the primitive two-branched condition (Fig. 76); in Œcanthus (Fig. 78) there is a single accessory cubital trachea; while in certain cockroaches, not figured here, vein Cu_1 is pectinately branched.

Similar variations in the number of branches of each of the other principal tracheæ of the hind wings occur. It is not

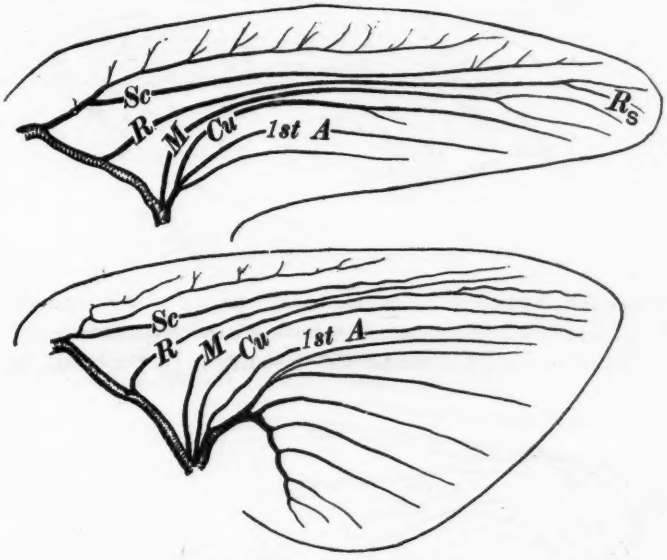


FIG. 75.— Wings of an Acridid nymph.

necessary to point them out in detail, as they are sufficiently indicated by the lettering of the figures. The most striking features are the reduction of the radius, the radial sector being at most unimportant, and in some cases entirely wanting, and the loss of the costal trachea.

In the fore wings the anal area is variously modified in the different members of the order. In the female Œcanthus (Fig. 78) it nearly retains its primitive form; in the Acridid,

represented by Fig. 75, a reduction of this area has taken place; while in the Blattidæ (Fig. 74) the three anal tracheæ are pre-

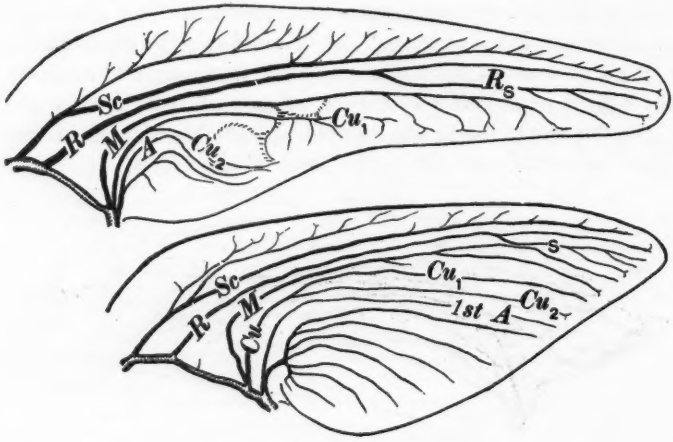


FIG. 76. — Wings of a nymph of Conocephalus.

served and the second and third have been specialized by addition, these tracheæ consisting of several parallel branches.

The cubital trachea is reduced to a nearly simple condition

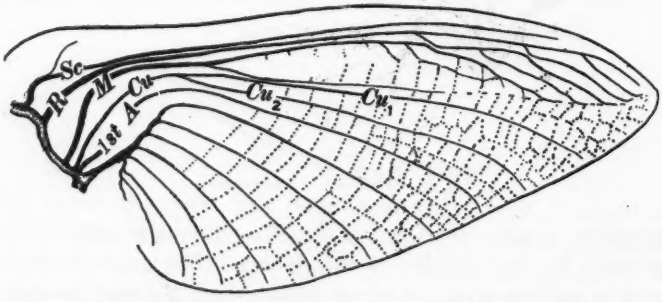


FIG. 77. — Hind wing of a nymph of Scudderia. Dotted lines indicate adult venation in part.

in the Acridid (Fig. 75); but in the other forms examined accessory tracheæ are developed on the caudal side of trachea Cu_1.

In the males of the Locustidæ (Fig. 76) and of the Gryllidæ (Fig. 79) the formation of a musical organ has been attained

by a modification of the cubital and anal areas. An extreme case of this is furnished by the male Œcanthus (Fig. 79). The principal vibrating area of the wing lies between the branches of the cubitus, which diverge widely in this sex.

A study of the musical organs of adult Orthoptera throws light on the nature of the anal furrow. In the female this furrow lies between the cubitus and the first anal vein; but in the males of the Locustidæ and Gryllidæ the anal furrow crosses

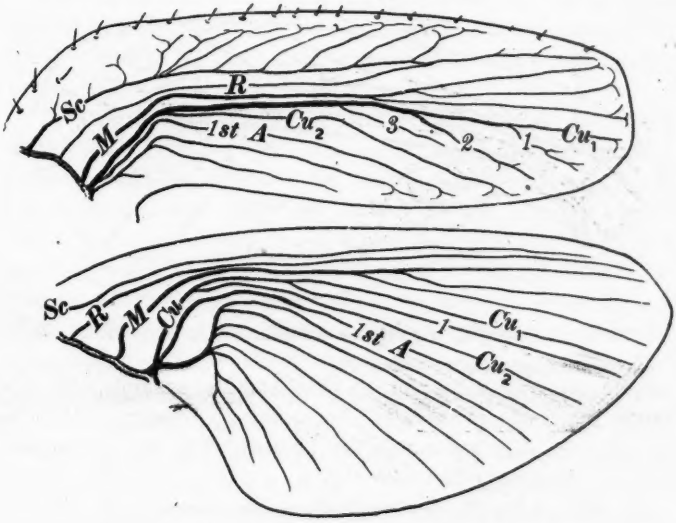


FIG. 78. — Wings of a female nymph of Œcanthus.

vein Cu_2. It is evident, therefore, that this furrow is merely a fold in the adult wing, and that its position is variable. It has already been shown [1] that in the Heteroptera, when an anal furrow is developed, it is in front of the cubitus, instead of in the more usual position between the cubitus and the first anal vein.

Although the wings of the two sexes of Œcanthus present a very different appearance, there is really a very close correspondence in the tracheation (and consequently in the vena-

[1] *American Naturalist*, vol. xxxii, p. 252.

tion) of the two, as can be seen by comparing the lettering of Figs. 78, 79; the same number of anal veins and of accessory cubital veins exist in the two sexes.

The lettering of the figures will serve to show the striking differences in the development of the remaining veins in different members of the order. Thus, for example, while the radius is the most prominent vein in the fore wing of the cockroach (Fig. 74), in Œcanthus (Figs. 78, 79) it is the least developed

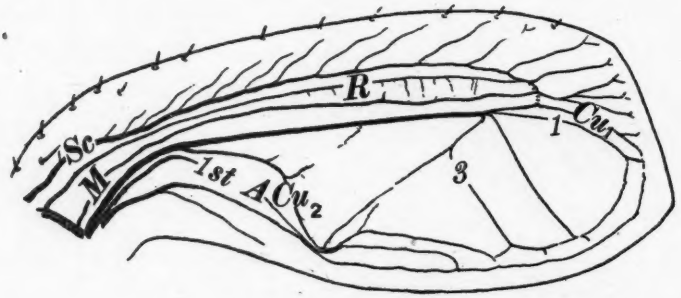


FIG. 79. — Fore wing of a male nymph of Œcanthus.

of the principal veins; or, to take another example, the subcosta is greatly reduced in the cockroach (Fig. 74), while in the Acridid (Fig. 75) and in the Locustid (Fig. 76) it is as well developed as any other vein.

In none of the Orthoptera that we have examined is the costal trachea distinctly preserved. Frequently, as in the Acridid (Fig. 75) and in the Locustid (Fig. 76), there is a prominent branch of the subcostal trachea which simulates a costal trachea; but that this is merely an overgrown branch of the subcostal trachea is evident when a series of forms are studied; in the hind wing of Conocephalus (Fig. 76) there are two such branches.

It will be remembered that in our hypothetical type the subcosta is two-branched, and that the branches are designated as Sc_1 and Sc_2 respectively. A good example of this typical branching of the subcosta is afforded by Nemoura.[1] But there

[1] *American Naturalist*, vol. xxxii, p. 238, Fig. 8.

are no indications that the primitive branching has been retained in the Orthoptera; here, when the two-branched condition exists, it is a secondary development; it would be misleading, therefore, to designate these branches as Sc_1 and Sc_2, for they do not correspond to the branches so designated in other orders. In this case the branch, or branches, of the subcostal trachea are merely accessory branches, like the accessory branches developed on other principal tracheæ.

Although the costal trachea has been lost, the thickening of the costal margin of the wing should be called the costal vein; for it is still the vein that was formed about the costal trachea in the beginning.

The few illustrations given here will show how easily the homologies of the tracheæ of the wings of orthopterous nymphs, and consequently of the veins that are formed about them, can be determined. But if one studies only the wings of adults, where many cross-veins have been developed, and where the basal connections of the principal veins are obscured, it is extremely difficult to determine these homologies. It is also evident that the wings of these insects present many characters which are easily available for taxonomic purposes.

The Position of the Orthoptera in the Class Insecta as indicated by the Tracheation of the Wings. — The making of genealogical trees does not fall within the scope of the present series of papers. Our object has been to learn in what ways wings have been modified in order to determine the homologies of the wing-veins. It is obvious that this had to be done before the characters presented by the wings could be used intelligently in working out the phylogeny of the orders. Now that this has been accomplished, it would be possible to propose a provisional classification of insects based on the characters of the wings; but we feel that it is much better to wait till the results we have attained can be correlated with similar studies of other organs. There is, however, one character in the tracheation of the wings to which it seems worth while to call attention now.

In most insects the principal tracheæ of the wings form two quite distinct groups. These we have already designated as the

costo-radial and the cubito-anal groups respectively.[1] To the former belong the costa, the subcosta, and the radius; to the latter, the cubitus and the anal veins. These groups find their attachment to the main tracheal system of the body at points wide apart; in the Perlid genus, Capnia, the former group springs from the dorsal lateral trunk, the latter from ventral lateral trunk of the thorax.[2] Even in such groups as Trichoptera, Hymenoptera, and Diptera, where great reduction has taken place, the persisting tracheæ clearly represent these two groups.

The media is sometimes a member of the costo-radial group (Fig. 80) and sometimes of the cubito-anal group (Fig. 76). In

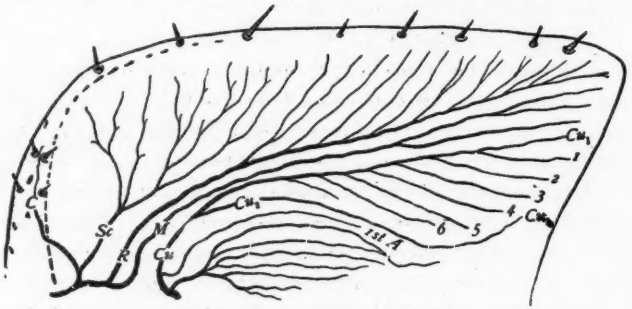


FIG. 80. — Fore wing of a nymph of a cockroach.

certain forms, however, the media arises midway between these two groups from a transverse basal trachea which joins them, suggesting at once the possibility of its migration from one group to the other. Since there is no evidence of its having entered the wing independently, to which of the two groups did it belong in the primitive winged insect? The answer lies (1) in the rank of the insects showing the different conditions, and (2) in the ontogeny of the media itself.

(1) Only in the Plecoptera and in some of the Blattidæ does the media clearly belong to the costo-radial group, and in these there is no basal transverse trachea connecting the two groups;

[1] *American Naturalist*, vol. xxxii, p. 88.

[2] A fact of no little interest in its relation to the question of a former respiratory function in these or closely related parts; since tracheal gills are commonly joined to both longitudinal lateral trunks, securing, doubtless, better distribution of the air.

in all other insects we have studied, the two groups are connected and the media is either joined to the cubito-anal group or arises from the transverse basal trachea. No one will hesitate to believe that the Plecoptera and the Blattidæ are the ones more likely to have retained the more primitive structure.

(2) We have previously shown[1] that in a Cicada nymph one-third grown the medial trachea springs from the transverse basal trachea midway between the radial and the cubital tracheæ, while in the grown nymph it has reached the cubital trachea. In most insects of which we have had nymphs of various ages we have observed the same direction of migration; never any migration in the opposite direction.

From this it follows that, in arranging the orders of winged insects in an ascending series, if we take into account only the structure of the wings, the Plecoptera should be placed first; for this order, as a whole, retains the primitive condition of the basal connections of the wing tracheæ. Next to this in degree of divergence from the primitive wing type stand the Orthoptera, with the Blattidæ the lowest of the series of orthopterous families; for in this family alone is the primitive condition of the basal connections of the wing tracheæ retained.

In this connection attention should be called to the striking similarity of the anal area of the hind wings in the Orthoptera and in the Plecoptera; in both cases the fanlike portion is supported by the second and third anal veins, while the first anal vein remains simple.

An understanding of the nature of the changes that are taking place in the basal connections of the wing tracheæ renders this region of the wing a very instructive one. Let us examine again the figures herewith given: In the wing of a cockroach, represented by Fig. 80, the primitive type is retained, the medial trachea is a member of the costo-radial group, and there is no transverse basal trachea; while in the wings represented by Fig. 74 the basal trachea is well developed, and the medial trachea has begun its migration toward the cubito-anal group, but it still arises from the basal trachea. In all other forms here figured the base of the medial trachea has nearly or quite

[1] *American Naturalist*, vol. xxxii, p. 249.

reached the cubital trachea and usually coalesces to a greater or less extent with it. An extreme case of this migration is illustrated by Xiphidium (Fig. 81). And here there appears to be a reduction of the transverse basal trachea. It has served its purpose, and, like an abandoned road, is disappearing from view. It will not be surprising if Locustid nymphs are found

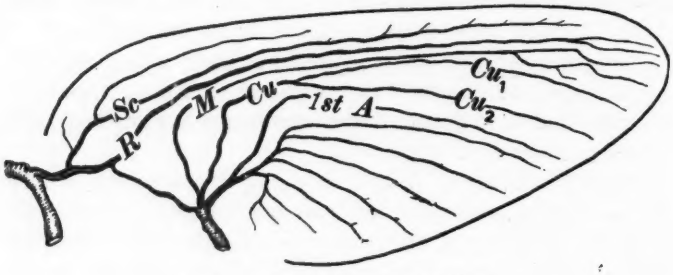


FIG. 81. — Hind wing of a nymph of Xiphidium.

in which this connection between the two groups is lost, but the presence of the medial trachea in the cubito-anal group will show it to have existed.

In the Acridid, represented by Fig. 75, the radial trachea is following the medial in its migration; this is indicated well by the curve near the base of the radial trachea in the hind wing.

VI. CONCLUSION OF CHAPTER IV.

In this and the preceding chapter we have furnished data for determining the homologies of the veins in each of the orders of winged insects except the Euplexoptera, Mecaptera, Isoptera, and the Physopoda. Of the first two we have been unable to procure immature stages; it is not probable, however, that they will present serious difficulties when they are studied. Of the Isoptera we have examined nymphs of two genera, Termes and Termopsis, but we wish to examine other forms before publishing conclusions. In all of the Physopoda that we have seen, the tracheation of the wings is so reduced that we have been unable to determine definitely the homologies of the few remaining tracheæ. We therefore close at this point our discussion of this phase of the subject and pass to a study of the beginning of wings.

ON NEW FACTS LATELY PRESENTED IN OPPOSITION TO THE HYPOTHESIS OF BIPOLARITY OF MARINE FAUNAS.

ARNOLD E. ORTMANN.

BIPOLARITY in the distribution of marine animals, indicated by Théel as early as 1886, has been proposed as a theory by G. Pfeffer.[1] Later, J. Murray[2] accepted the theory and tried to support it by a careful collection of facts. From the beginning the present writer, chiefly relying on the investigation of the distribution of decapod crustaceans, vigorously objected to the theory, and expressed his views as early as 1894 and 1895,[3] contending that the cases introduced by Pfeffer were not correct. In 1896, after the publication of Murray's paper, the writer published an article[4] dealing with the subject more closely, and arrived at the conclusion that bipolarity does not exist as a general law of distribution among the decapod crustaceans, and that it seems very improbable that such a law may prevail among other groups of animals.

J. Murray disregarded these objections, and on different occasions[5] continued advancing bipolarity as a distributional fact, which called forth repeated objections on the part of the writer.[6] Since then (1897) other zoölogists have taken part in

[1] *Versuch über die erdgeschichtliche Entwicklung der jetzigen Verbreitungsverhältnisse unserer Thierwelt*, p. 38. Hamburg, 1891.

[2] *Trans. Roy. Soc. Edinburgh*, vol. xxxviii (1896), No. 2, p. 494.

[3] *Jenaische Denkschr.*, Bd. viii (1894), p. 76, and *Grundzüge der marinen Thiergeographie*, p. 52. (This latter book was issued in December, 1895, but bears the date 1896 on the title-page.)

[4] *Zool. Jahrb., Syst.*, Bd. ix (1896), pp. 571 *ff.*

[5] *Nature*, vol. lv (1897), No. 1430, p. 500, and in *The Geograph. Journ.*, vol. xii (1898), No. 2.

[6] *Zool. Jahrb., Syst.*, Bd. x (1897), p. 217, and *Science*, vol. viii (1898), p. 516. Pfeffer (*Zool. Anzeig.*, Bd. xx, September, 1897) has referred to the first of these objections; but since he does not discuss the matter at all, and only doubts the ability of the writer to investigate this topic, it is better not to consider this note.

the discussion, and at present we possess the results of a number of investigations in special groups of animals, dealing with the relations of the Arctic and Antarctic faunas. All the results obtained tend to show that the original contention of the writer, derived from a study of the decapods, is fully supported by the facts found among other groups, so that the theory held by Pfeffer and Murray, that both polar faunas are more closely related to each other than to any of the intermediate ones, is without support. In fact, there have been added very few cases of bipolarity of genera to the single case established by the writer in 1895,[1] and one case of a bipolar species, discovered by Chun, is to be looked upon with some suspicion, for he himself suggests an explanation. All this points to the confirmation of the opinion of the writer, that, although some cases of bipolarity may exist, such cases are extremely rare, and may be explained in one of the ways indicated in his paper of 1896, while the greater part of each polar fauna consists of peculiar forms, which show no closer connection with each other than with forms found in tropical latitudes.

We will now review the chief results of the papers recently published, and then draw conclusions as to the theory of bipolarity. However, it is well to observe that some of the authors referred to did not give all the necessary data. Especially is there a lack of information as to the distribution of genera found in both polar seas, outside of their polar range. The writer has tried to supply this deficiency by consulting other papers, but as he cannot claim to be a specialist in the respective groups, he has in some cases failed. Further, a misunderstanding seems to exist on the part of some authors as regards the term "bipolarity"; they sometimes call a species or genus that is found in both polar areas bipolar, although it is also present in intermediate localities. But "bipolarity," as understood by Pfeffer and Murray and the present writer, implies that a bipolar form is wanting in the intermediate tropical parts of the seas, and the chief difficulty in the discussion is the explanation of such cases of *discontinuity* in distribution.

The first paper to be discussed is an investigation of the

[1] *Proc. Acad. Philad.* (1895), pp. 189–197.

pelagic faunas of the Arctic and Antarctic, by C. Chun.[1] He collects the records of the occurrence of the animals constituting the plankton of the polar regions (Protozoa, Medusæ, worms, crustaceans, mollusks, Tunicata, and fishes), and although he complains in many cases of a general lack of information, especially as to the Antarctic pelagic life, he reaches some very important conclusions. He recognizes a general similarity of both faunas, which finds its chief expression in the prevalence of certain groups in both areas and the absence of others; and, further, he mentions the presence in both polar seas of two identical species, one a worm (*Sagitta hamata*), the other a Tunicata (*Fritillaria borealis*). The first case, that of *Sagitta hamata*, is treated more in detail, and Chun shows (after Steinhaus and Lohmann) that this species, which has been found near the surface in both polar seas, crosses the Atlantic Ocean. It is not, however, found there near the surface, but at considerable depths (300–1500 m.). Thus, for this pelagic species, a connection of the Arctic and Antarctic range through the tropics, but in deeper water, is established (analogous to the connection of littoral polar forms along the bottom of the deep sea), and Chun concludes that this connection, once having been proved, is sufficient to explain other cases, and that there is no need to have recourse to theories which, like Pfeffer's and Murray's, go back to former climatic conditions of the earth. Yet in the writer's opinion this conclusion is not satisfactory. We do not want to know how an individual case *may* be explained, but we want to know how it can be explained *correctly*. Although we must appreciate the value of the case represented by *Sagitta hamata*, still there remains the question to be settled, whether other cases of bipolarity, which may be discovered, are really cases of bipolarity, where there is no connection of both ranges, and whether such cases are to be explained by the Pfeffer-Murray theory, or by other means, as indicated by the present writer. But at any rate Chun's paper shows plainly that cases of bipolarity among pelagic organisms seem to be *very rare*.

[1] *Die Beziehungen zwischen dem arktischen und antarktischen Plankton.* Stuttgart, 1897.

All the other papers under consideration discuss littoral and abyssal animals. In an article on the history of the marine fauna of Patagonia, H. von Ihering[1] compares the Antarctic mollusks with those of the Arctic. He mentions 9 species that are found in both polar seas, but at the same time he says that this list comprises almost exclusively such species as are of a very large or universal distribution. The connection of the polar localities of these forms is chiefly through the deep sea. There are no true bipolar *species*, and if we regard the *genera* present or wanting in the Arctic and Antarctic molluscan faunas, both differ considerably.

Breitfuss[2] has published a study of the distribution of the calcareous sponges of the Arctic seas, and incidentally compares them with those of the Antarctic. Of 42 Arctic species only a few (6) cross the equator, and a single one extends its range into the southern polar regions (*Grantia capillosa*). The rich Calcispongiæ fauna of the Australian and New Zealand coasts is very distinct from that of the Arctic, and from the Magellan, South Georgian, and Kerguelen regions only 6 species (belonging to 4 genera) are known, which, with the exception of *Grantia capillosa*, are different from the northern species; and of these genera one (Leucetta) is missing in the Arctic Ocean, while, on the other hand, numerous Arctic genera (6 out of 11) are not known from the Antarctic. No case of bipolarity, either of a species or genus, is mentioned, and the author says nothing about a resemblance of faunas of both seas.

Herdman[3] refers to the extra-tropical southern tunicate fauna of Australia, and, without going into further detail, states that there is no special relationship between it and the tunicate fauna of the northern hemisphere. As to Murray's extracts, from his report on the distribution of the Challenger-Tunicata, he says that the distributional data given in this report are not complete, and, he says, "have to be added

[1] Zur Geschichte der marinen Fauna von Patagonien, *Zool. Anzeig.*, Bd. xxvii, December, 1897.

[2] Die arctische Kalkschwammfauna, *Arch. f. Naturg.*, Bd. i (1898), Heft 3.

[3] *Ann. Mag. Nat. Hist.*, Ser. 7, vol. i (1898), and *Trans. Liverpool Biol. Soc.*, vol. xii (1898), p. 251.

to or modified in such a way as to entirely change the nature of their evidence, and show that there is no such close resemblance between the northern and southern polar faunas as Dr. Murray and others have supposed." In fact, he states plainly that among the simple ascidians no cases of bipolarity are known.

D'Arcy W. Thompson[1] has reëxamined the list of bipolar animals given by J. Murray. This list contains nearly 100 species, but d'Arcy W. Thompson shows (p. 347) that there are among them "more than one-third in which grave doubt as to their identification was expressed by the original describers, or in which the identification has been doubted or denied by later writers. In somewhat more than another third the evidence of identity is inconclusive or even inadmissible by reason of the nature of the examination to which the specimens were subjected, or by reason of the small size of the objects and lack of adequate marks of characterization. Of the remaining forms, about a dozen find their northern representatives in the Japanese seas, where they form part of a fauna predominantly southern in its relations, and where at least the occurrence of any particular form cannot be taken, *ipso facto*, as evidence of a boreal center of distribution."

After deducting these forms the list shrinks into very little. There remains, aside from 12 deep-sea species, only a single littoral annelid species (*Terrebellides strœmii*), and 2 pelagic species, a mollusk, *Janthina rotundata*, and a copepod, *Calanus finmarchicus;* but even these last two hardly seem to be bipolar, since neither of them is recorded from further south than 35° S. L., and the latter seems to be rather a cosmopolitan form (see note on p. 349, *loc. cit.*).

Further, d'Arcy W. Thompson gives an examination of the Antarctic fishes, isopods, and amphipods, with special reference to bipolarity. He finds no species in any of these groups to inhabit both the Arctic and Antarctic Oceans, and he sees no signs of a likeness of both faunas.

A valuable series of monographs has been published by

[1] On a Supposed Resemblance between the Marine Faunas of the Arctic and Antarctic Regions, *Proc. Roy. Soc. Edinburgh* (1898), pp. 311–349.

H. Ludwig,[1] treating of the distribution of the holothurioids, crinoids, and ophiuroids, with special reference to their polar ranges. The part on the holothurians is especially interesting, since it was this group that first suggested to Théel the idea of bipolarity. According to Ludwig there are no bipolar species, and, in respect to the genera, there is not a single instance that shows the slightest indications of bipolarity. Out of 10 genera found in both polar regions, 5 (Stichopus, Cucumaria, Thyone, Phyllophorus, Chirodota) have been found abundantly in the littoral parts of the tropics, and 4 (Bathyplotes, Mesothuria, Trochostoma, Ankyroderma) are connected in the deep sea; and the same seems to be true of Psolus, which has been reported from tropical latitudes, although it seems to be rarer there. Aside from these 10 genera mentioned, there are 9 genera peculiar to the Antarctic, and 6 peculiar to the Arctic (but some of them extend into the tropics), thus giving a different character to the two faunas. The general result in the other two groups studied by Ludwig is practically the same; there are no bipolar species, and the number of genera peculiar to each fauna is larger than the number of genera common to both. Among the crinoids there is only 1 genus (Antedon) found in both areas, while 3 are peculiar to the Antarctic (2 of them abyssal) and 1 peculiar to the Arctic, and among the ophiuroids 6 genera are common to both areas, while 9 are peculiar to the Antarctic and 8 to the Arctic.

The genus Antedon found in both polar seas is very interesting. Both the Antarctic and Arctic species belong exclusively to two sections of the genus, *A. eschrichti* and *A. tenella*. The Tenella group is found in all parts of the world, so that there is nothing remarkable about its distribution. The Eschrichti group, however, contains 4 littoral Antarctic species and 3 littoral Arctic species (2 of them also abyssal), the latter all from the North Atlantic. Now it is very significant that some kind of a connection is afforded by one of the Antarctic species, namely, *A. rhomboidea*. This species has been found in the littoral of the southern end of America, and its range extends northward

[1] *Hamburger Magalhaensische Sammelreise.* Holothurien, 1898; Crinoideen, 1899; Ophiuroideen, 1899.

along the western coast of America to 22° N. L., but there it has been dredged at greater depths (1200–1400 m.). Although no species of this group has yet been found in the northern Pacific, it is very probable, nevertheless, that such species do exist. In that case we would here have again an instance of a connection, along the western coast of America, of an apparently bipolar group of marine animals. Examples of this kind have been pointed out, by the present writer, among the decapods.

Of the 6 ophiuroid genera common to both the polar seas, 4 (Ophioglypha, Ophiactis, Amphiura, Ophiacantha) are also represented in the littoral of the tropics. The 2 remaining genera (Ophiocten, Gorgonocephalus) are chiefly abyssal genera, and, as far as the writer could determine, Ludwig does not give any information — at least, Ophiocten is also found in tropical latitudes.

Thus in these three groups we have again the same result: that bipolarity, if present at all, is extremely rare, and that the most prominent feature of the respective faunas of the polar seas consists in their dissimilarity.

Yet Ludwig calls attention to a certain general likeness of both faunas, expressed by the mutual prevalence of certain genera and the mutual lack of others as compared with the tropic faunas. This is not to be regarded at all as a remarkable fact, and has no connection with the question under discussion; indeed, it would be very strange if other conditions prevailed. When, out of a number of genera present in the tropics, a certain number disappears as we approach either pole, while a certain number does not, this shows only that the latter are not affected by the change of conditions, — chiefly climatic, — while the former are, and of course by the disappearance of a number of types the percentage of the remaining must increase, if the deficiency is not made up by other genera making their appearance in the colder regions. This is again an instance where statistics give a wrong idea of the true conditions; the increase of the percentage of certain genera in the polar seas is not due to an actual increase of species and a more vigorous development, but only to the lack of species of other genera.

Lastly, we have a paper, by O. Buerger,[1] treating of a group of worms, the nemertines. Buerger does not go much into detail, but we must attribute this chiefly to our scant knowledge of this group. Again, there are no bipolar species; the only two species which have been found in corresponding latitudes on both hemispheres are circum-tropical, and enter extra-tropical parts only on the northern and southern limits of their range. As regards the genera, all Antarctic genera (9) are also found in the Arctic. Buerger says that a general similarity of both polar faunas is thus indicated, but the lack of 12 Arctic genera in the Antarctic does not support this view; and since he says, further, that neither of the faunas seems to possess very characteristic types, as do the tropics, it is evident that these 9 genera common to both polar faunas are also represented in the tropics. There is, however, one genus that seems to be bipolar; Carinoma, which has been found on the coast of England (*C. armandi*) and in the Straits of Magellan (*C. patagonica*).

There is no doubt that the facts presented here do not at all support the theory of bipolarity. The contention of Pfeffer and Murray is that bipolarity forms a very striking feature of the polar faunas. This has been denied by the present writer with regard to the decapod crustaceans, and now von Ihering has confirmed this latter opinion for the mollusks, Breitfuss for the Calcispongiæ, Herdman for the tunicates, d'Arcy W. Thompson for the fishes, isopods, and amphipods, Ludwig for the holothurians, crinoids, and ophiuroids, Buerger for the nemertines, and Chun for the entire bulk of the pelagic fauna.

Two cases of bipolarity of species and one of genera have been discovered, and when we add these to the single case previously established (Crangon), we have altogether four cases of true bipolarity which are to be explained by a theory. In all other cases the supposed bipolar range of a species or group has been connected by intermediate localities, and these connections are of two kinds: (1) connection along the bottom of the deep sea or in deeper strata of the tropical parts of the open

[1] *Hamburger Magalhaensische Sammelreise.* Nemertinen, 1899.

sea (Ortmann, von Ihering, Thompson, Chun, Ludwig); (2) connection along the western shores of the continents, mostly connected with a descending of the respective forms into deeper water (Ortmann, Bouvier, Thompson, Ludwig).

It is possible that by these ways cases of true bipolarity may develop, provided these connections become discontinued. The writer has explained a true case of bipolarity (Crangon) by one of these ways. But, on the other hand, it is also possible that bipolarity is to be explained by the Pfeffer-Murray theory in some cases by former conditions of the earth's history, especially those existing at the beginning of the Tertiary period. Yet we do not know any concrete case of this kind, and we must wait for further investigation to show whether bipolarity as a *relic* of older times is realized in the geographical distribution of any marine animals.

SYNOPSES OF NORTH-AMERICAN INVERTEBRATES.

I. Fresh-Water Bryozoa.

C. B. DAVENPORT.

These minute animals are found very abundantly in ponds and streams. Upon the underside of floating boards or of fallen tree trunks, in quiet pools or ponds, one may find the branching Plumatellas and Fredericella; upon rocks one often finds the *Plumatella punctata* in crowded masses. In pond-bottoms or in slow-moving streams Cristatella may be found on leaves of aquatic plants or bottom *débris*. More rapid streams afford Paludicella and Pottsiella. Below milldams, where the waters are turbulent, Urnatella and Pottsiella have been found together on stones. In reservoirs near where the waters are being pumped in, or on the gates of milldams, one may look for Pectinatella. Since all species form colonies by budding, compounds of Bryozoa may be formed of great size. Some of the Plumatella colonies stretch over a plain surface six inches in diameter, and a Pectinatella colony may become by the end of summer a sphere two feet or more in diameter. Bryozoa prefer the shade, and hence are more apt to occur in places not directly illumined by the sun's rays.

Fresh-water Bryozoa pass the winter in an inactive stage. The Phylactolæmata produce little seed-like bodies called statoblasts. These may be found as minute brown bodies floating on the surface of ponds in the winter and spring. If some of these are brought indoors in the early spring, they will hatch out after a few days, revealing a double embryo, which is one of the most beautiful objects for microscopic observation. The food of fresh-water Bryozoa consists of minute plants suspended in the water, such as diatoms.

FIG. 1. — A, *Plumatella polymorpha*, var. fungosa, small part of mass, natural size. B, *Plumatella polymorpha*, var. repens, on leaf of water lily, natural size. From Cambridge Natural History.

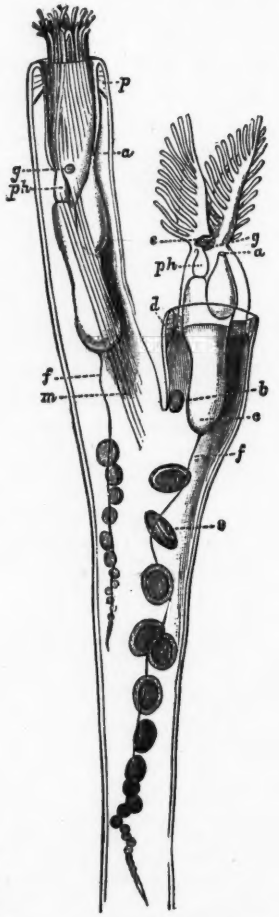


FIG. 2. — *Plumatella polymorpha*, var. repens × 30. *a*, Anus; *b*, polypide-bud; *c*, cæcum of stomach; *d*, duplicature or kamptoderm; *e*, epistome; *f*, funiculus or germinal strand; *g*, ganglion; *m*, retractor muscle; *p*, parieto-vaginal muscles; *ph*, pharynx; *s*, statoblasts developing on funiculus. From Cambridge Natural History.

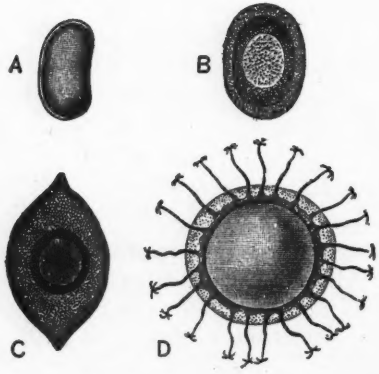


FIG. 3. — Statoblasts of Phylactolæmata. A, *Fredericella sultana* × 38; B, *Plumatella polymorpha* × 38; C, *Lophopus cristallinus* × 28; D, *Cristatella mucedo* × 28. From Cambridge Natural History.

Key for the Determination of American Fresh-Water Bryozoa.[1]

a_1. Anus opening inside the tentacular corona [Endoprocta]. *Urnatella gracilis.*

a_2. Anus opening outside the tentacular corona, which is capable of being retracted [Ectoprocta].

b_1. Zoœcia sharply separated from each other; no epistome [Gymnolæmata].

c_1. Zoœcia cylindrical, arising from stolons; aperture terminal. *Pottsiella erecta.*

c_2. Zoœcia club-shaped, no stolons; aperture lateral. *Paludicella ehrenbergii.*

b_2. Zoœcia confluent, epistome present [Phylactolæmata].

c_1. Statoblasts without thorns, rounded at ends.

d_1. 20–22 tentacles arranged nearly in a circle; statoblasts without peripheral float. *Fredericella sultana.*

d_2. 38–60 tentacles arranged in form of horseshoe. Free elliptical statoblasts with a peripheral float [Plumatella].

e_1. Free statoblasts elongated; proportions, 1 : 1.53 to 1 : 2.8. *Plumatella princeps.*

e_2. Free statoblasts nearly circular, 1 : 1 to 1 : 1.5.

f_1. Free ends of zoœcia fairly distinct from basal tubes, cylindrical or irregularly constricted. *Plumatella polymorpha.*

f_2. Free ends of zoœcia mere conical elevations of basal tubes, covered with white spots. *Plumatella punctata.*

c_2. Statoblasts acutely pointed at both ends, without thorns. *Lophopus cristallinus.*

c_3. Statoblasts with anchor-shaped thorns.

d_1. Zoöids form rosettes on a gelatinous base, often attaining great size. *Pectinatella magnifica.*

d_2. Stock caterpillar-like, with broad sole. *Cristatella magnifica.*

Literature on Fresh-Water Bryozoa.—Allman, G. J., A Monograph of the Fresh-Water Bryozoa, London (*Roy. Soc.*), 1856.—Hyatt, A., Observations on Pólyzoa, Suborder Phylactolæmata, *Proc. Essex Institute*, IV and V, 1866–1868.—Leidy, J., Urnatella Gracilis, *Journ. Acad. Nat. Sci. Philad.*, 1883.—Potts, E., On Paludicella Erecta, *Proc. Acad. Nat. Sci. Philad.*,

[1] The *American Naturalist* will undertake to determine and return any specimens that cannot be placed in the keys, and solicits correction and criticism for future revision.

1884. — Kraepelin, K., Die Deutschen Süsswasserbryozoen, Teil I, *Abh. Naturw. Verein*, Hamburg, X, 1887; Teil II, *ibid.*, XII, 1893. — Braem, F., Untersuchungen ueber die Bryozoen des süssen Wassers, *Bibl. Zool.*, II, 1890. — Davenport, C. B., Cristatella: the Origin and Development of the Individual in the Colony, *Bull. Mus. Comp. Zool.*, Harvard, XX, 1890, and on Urnatella Gracilis, *Bull. Mus. Comp. Zool.*, Harvard, XXIV, 1893.

NOTES ON THE HABITS OF BASCANION CONSTRICTOR.

W. E. PRAEGER.

EARLY in August, 1898, when staying on a farm in Hancock County, Ill., I captured a fine black snake (*Bascanion constrictor*), a typical specimen about five feet long. One hot afternoon we were disturbed by the alarming report that a snake was in the henhouse. I investigated and found the snake among the boxes and straw, but for a moment the species puzzled me. Only its head and a small part of its body could be seen lying on the eggs of a hen's nest. Immediately behind the head the neck was greatly distended, colored pink and yellow, with fine longitudinal lines of black spots. Closer inspection showed that the black lines were rows of scales on the greatly stretched skin of the neck, and its guilt as a nest robber was manifest. The snake lay perfectly quiet, and as seizing it by the neck in the orthodox manner was impossible without breaking the egg it had swallowed, I took hold of it by the body. As though in preparation for fight or flight the egg was at once broken, apparently by some muscular contraction, the contents running out of the mouth, and the neck quickly assuming its normal proportions. During the five weeks that it was in captivity I frequently offered eggs to it, but no other food, for I was interested to see how such a small pair of jaws could encompass an entire hen's egg; but it refused to gratify my curiosity, and ate nothing while I had it.

The snake was kept in a small box, but was frequently released on the porch or lawn, and allowed its freedom for a while. Its one idea seemed to be to escape, though it went about it deliberately, and did not show any signs of fright. When touched, it struck quickly with open mouth at the object, but the wounds inflicted in this way on my hand were very

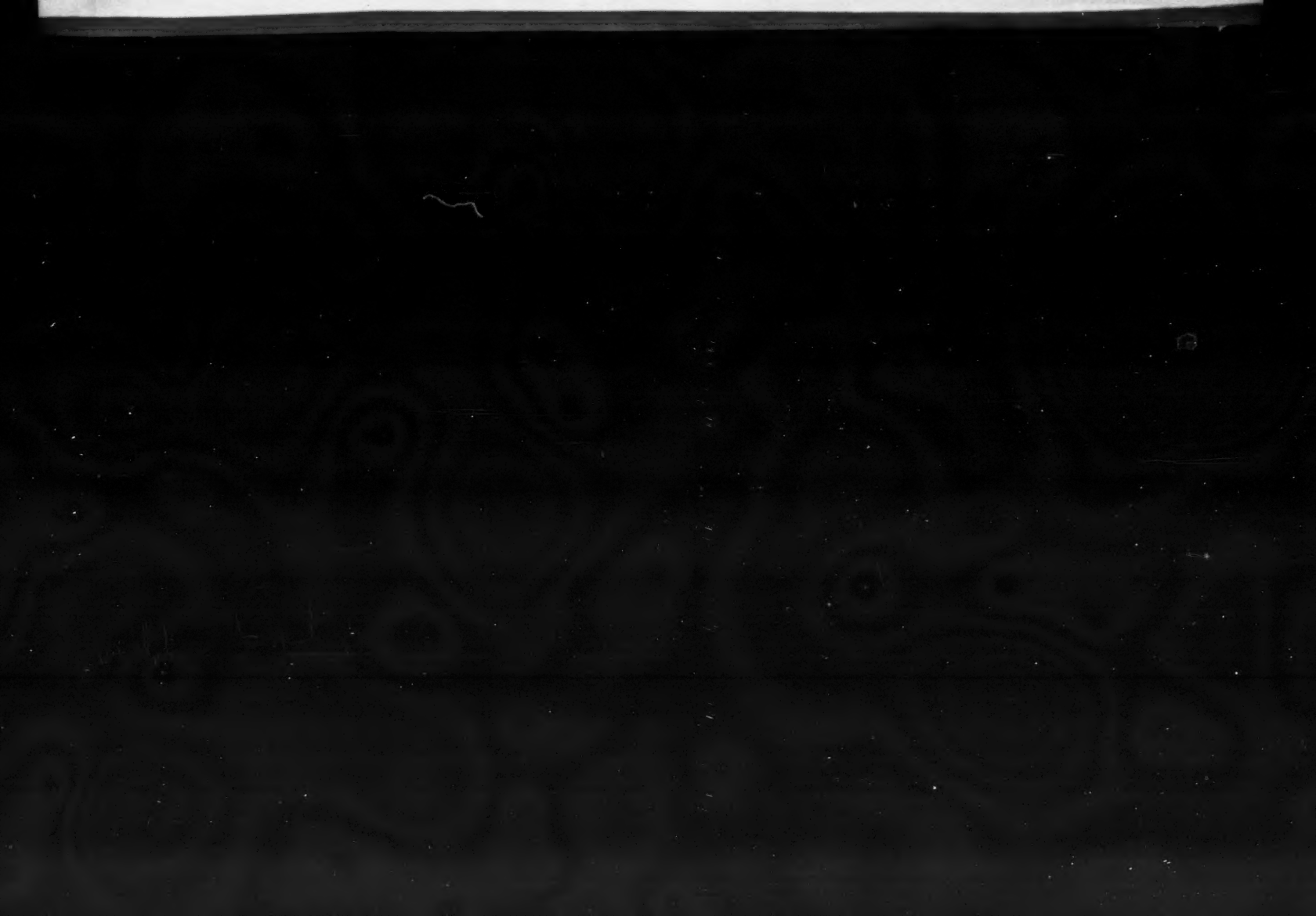
trifling. Black snakes have been described as expert climbers, which my captive soon showed me to be true. On the lawn stood a fine black oak (*Quercus tinctoria*), the trunk eight feet in circumference, perfectly straight, and for fifteen feet without a branch. Up this trunk our snake would go, apparently preferring it to the smooth lawn as a way of escape. The course pursued was always right up one side of the tree, and no attempt was made to encircle it. The general direction was perpendicular to the ground, the irregular curves of the body being comparatively slight. Once clear of the ground, progress was very slow; the head and neck were sometimes moved deliberately from side to side, presumably in search of a good hold. It never moved hurriedly, and there was probably always some part of its body not in motion, though this was not always apparent. It took close inspection to see that, here and there, the edge of a ventral plate was caught on some slight projection of the bark, and even then the appearance of the snake against the perpendicular trunk of the tree seemed like a defiance of the law of gravity. The muscles were thrown into unusual prominence, and constantly changed in appearance throughout its length, their contractions showing the effort needed to make the ascent.

Once while I was absent the snake escaped from its box and climbed up the smooth stone wall of the house, to a height of about thirteen feet, aided only by a few small nails and a wooden moulding above the arch of a door.

In more favorable situations our captive showed that climbing by black snakes was not necessarily slow and laborious. The ease and silence with which it could glide through the loose tangle of the vines (*Ampelopsis quinquefolia*) that covered the porch railing was remarkable; and to disentangle it from this, or from among the branches of some bushes that grew near, was not easy. A single crook of its muscular body across a branch made a firm hold, but it never twisted itself entirely around a branch. It would make for any hole that offered; the hollow stump of a small tree was a favorite retreat, and when even but a short way into this hole it was no easy matter to get it out. The body was bent so that it was pressed

against the rough sides of the cavity, and it was only by main strength on my part, and always with injury to its scales and plates, that it could be pulled out.

Placed on a porch floor, the body and tail were lashed in strong curves from side to side, but forward progress was very slow. On the tennis lawn the curves of the body were less pronounced, and the forward movement more rapid. However, it was only when it reached long grass or rough ground that the snake straightened out and went forward with that mysterious gliding motion peculiar to its kind. As an onlooker once described it, "when he strikes rough ground he quits wiggling and just scoots."



A NEW NAME FOR THE GREAT CRESTED ANOLIS OF JAMAICA.

LEONHARD STEJNEGER.

HERPETOLOGICAL writers have shown a curious unanimity in misnaming the large crested Anolis of Jamaica *Anolis edwardsii*, Merrem.

Merrem, in 1820 (*Syst. Amph.*, p. 45), gave the name *Anolis edwardsii* to a lizard figured by Edwards as "the Blew Lizard from the Island of Nevis," and never mentioned Jamaica as its habitat. Merrem knew nothing of the species beyond Edwards's description and figure, upon which, consequently, the specific name rests.

Edwards, in his *Gleanings of Natural History*, Vol. I, p. 74,[1] describes, and on Pl. 245 figures "immediately from nature, and of the size of life," an Anolis which "was brought from the island of Nevis, in the West Indies, by a young gentleman who came to London for education," and who presented it to him "preserved in spirits." After alluding to the digital expansion of this lizard as its most particular feature, he says: "It hath a small ridge down its back, which extends to the tail, where it becomes jagged or toothed."[2] We do not expect to find in a drawing of 1753 all the minute details which would enable us to identify with certainty a lizard of this extremely difficult genus, but Edwards's figure shows very well the above-described features, namely, a nearly smooth dorsal fold continued as a toothed crest on the tail. This alone is sufficient to show that he did not have before him the Jamaican large crested Anolis, the very character of which is the "dorso-

[1] This volume, in the edition of 1805 at least, is erroneously indicated on the title-page as "Volume V."

[2] "Il y a une petite élévation sur le dos, en forme de sillon, qui règne tout du long jusqu'à la queue, où elle devient dentelée" (French rendition in the parallel column).

nuchal crest of triangular scales," or, in other words, a crest on the back precisely like that of the tail, and not at all like the dermal fold so characteristic of another group of Anoles. Add to this that Edwards's figure is life size, and yet only about one-half that of the Jamaican species, and that the latter, or any species of the same group, does not occur on Nevis, nor in fact on any of the Caribbean Islands, while another species of the group with the dorsal fold is known to live on Nevis, and the conclusion is inevitable that the great crested Anolis of Jamaica has been wrongly named *A. edwardsii.*

As it has received no other name, a new one has to be provided, and I propose to call it *Anolis garmani,* in recognition of Mr. S. Garman's important studies of West Indian Anoles. I may add that the species is briefly mentioned by Sloane (*Nat. Hist. Jamaica,* Part II, 1725, p. 333) as *Lacertus major e viridi cinereus, dorso crista breviori donato,* and figured on Pl. 273, Fig. 2. This has usually been referred to *Anolis equestris,* from Cuba, but is plainly the Jamaican species. It is certain that true *A. equestris* does not occur in Jamaica.

EDITORIAL COMMENT.

"Scientia." — We are glad to note the establishment of a new French scientific series — "*Scientia*, exposé et développement des questions scientifiques à l'ordre du jour." This is to appear in two parts: one, a physico-mathematical one; the other, biological, which chiefly concerns us. The aim of the series is to exhibit in a clear and philosophical way the results of recent discoveries and the general directing ideas. It is proposed to treat the subjects in a living way, giving reasons for conclusions and the conflict of views. The cost of each volume, neatly bound in cardboard, is two francs, or six for ten francs.

There is room for such a series, and the first two volumes which we have received, one by Bard on Cell Specialization, and one by le Dantec on Sexuality, lead us to expect good things from the undertaking.

Western Morphologists. — We have recently received a letter from Professor Henry B. Ward, of Nebraska University, suggesting the formation of a western section of the American Morphological Society. This is a matter which the *Naturalist* would like to see fully discussed. We have already referred to the fact that the very extent of our country works against a proper unity of American scientific men, and that a society which meets in successive years at places five or seven hundred miles from one another loses that continuity of endeavor essential to the most effective work. We are consequently at present inclined to regard the suggestion of Professor Ward as good, and to believe that the formation of a section of the "Morphologists" in the Mississippi Valley, which might meet once in three or five years with the Society of Naturalists and the eastern section of the "Morphologists" at some border-line city, would serve to develop the science in America.

REVIEWS OF RECENT LITERATURE.

GENERAL BIOLOGY.

The Specialized Nature of Cells.[1] — The author brings facts, largely from the medical literature, to support his modification of Virchow's famous dictum, so that it reads: *Omnis cellula e cellula ejusdem naturæ.* In the first chapter he discusses the relative claims of the theories of the indifferent nature and the specialized nature of cells in the body. Next he considers the hereditary fixity of cell-types in adult organisms, and attempts to show that all conclusions that in pathology or regeneration the organs of new growths arise from other than like cells in the body, rest upon erroneous interpretation. Unfortunately many of the best cases supporting the view he combats (such as Wolff's case of the regeneration of the Amphibian lens) are not considered by the author. The third chapter deals with the origin of specialization of cells during development, which he believes comes in with the germ-layers. Finally cell specialization is considered from the standpoint of life and heredity.

Although one-sided and speculative, the book has a value as giving the point of view of a medical man.

Sex.[2] — This small book, by the well-known French writer on topics of a general biological nature, gives a résumé of the general facts of sexual dimorphism, parthenogenesis, the dependence of the secondary sexual characters on the primary, the epoch and conditions of sex-determination, and the theory of sex. In the chapter dealing with secondary sexual characters the author considers sexual selection, the results of castration, and the phenomena of hermaphroditism. Other chapters are treated with equal fullness.

The author proposes a hypothesis of sex which he admits is very uncertain. It is that all the elementary living substances have two inverse and complementary types; just as many inorganic molecules appear in two forms. One of these types is the male; the other the female type.

[1] Bard, L. La Spécificité Cellulaire, ses consequences en biologie générale, *Scientia, Sér. Biologie, No. 1.* Paris, Carré & Naud, 1899. 98 pp.

[2] Le Dantec, F. La Sexualité, *Scientia, Sér. biologique, No. 2.* Paris, Carré & Naud. 99 pp.

The work is clearly written, and the author frequently reduces his statements to a mathematical form. The book will be useful to teachers.

The Removal from the Water of Nitrogenous Matter Excreted by Marine Animals has been investigated by Mr. H. M. Vermon, at the Naples Station, by chemical, physiological, and bacteriological methods. Green seaweeds in aquaria remove the free, but increase the albuminoid, ammonia, and favorably affect the growth of sea-urchin larvæ. Neither form of ammonia is decreased by the red seaweeds, and larvæ do not thrive in the water except in direct contact with a small quantity of the weed. Sand with no vegetable matter had no purifying power, but when clogged with diatoms and algæ, it removed as high as 96 per cent of the free, and 51 per cent of the albuminoid, ammonia. Bacteria are important agents in the purifying process, especially in the removal of the free ammonia. The bacterial slime lining the aquarium pipes materially purifies the water. Purification is greatest at the maximum rate of filtration, though the number of bacteria is increased considerably by the use of the clogged sand-filter. The removal of the ammonia favors the development of the larvæ.

C. A. K.

ANTHROPOLOGY.

Physical Qualities of the Children of Prague.[1] — Dr. Matiegka, one of the foremost Czechish anthropologists, has contributed largely to the knowledge of Bohemian craniology and other subjects. The present work is a contribution to the study of school children of the capital of Bohemia. It has been preceded by studies "On the Influences which Act on the Weight and Length of the New-Born Children in Bohemia,"[2] "On the Period of Puberty among Bohemian Girls,"[3] etc., by the same author. The work at hand is full of interesting details and comparisons, and well deserves a translation into the English language.

The children included in the examinations range from 5½ to 14

[1] Matiegka, Jindrich. The Growth, Evolution, Physical Qualities, and the Hygienic Conditions of the Children of Prague, *Trans. Bohem. Acad. of Sci. and Art*, Ann. vi, Cl. ii, No. 17, pp. 1–78, with tables. Prague, 1898.

[2] *Journ. of the Bohem. Phys.* (1894), p. 245.

[3] *Bull. of the Bohem. Assoc. of Sci.* (1897), XV.

years of age. There were ascertained with each child the date of birth, state of nutrition and of musculature, height, weight, circumference of the head, circumference of the thorax at inspiration and at expiration, color of eyes and hair, condition of teeth, principal qualities of sight and hearing, morals, abilities, and existence of diseases past and present. The actual examinations were conducted principally by the teachers of the children, the whole work being authorized and supported by the municipality.

Among the main results of the investigations the following are important:

Births. — The maximum rate of conceptions occurs in May and a part of June.[1] In the months in which the greatest numbers of children are born there is also observed the greatest average weight of children. The vitality of the children born in these months does not suffer.

State of Nutrition. — Only about one-half (49.8 per cent) of all the children examined were found to be "well nourished," which shows us best what conditions exist in the large European cities, Prague in no way being an exception. Seven and six-tenths per cent of the children examined were nourished "badly." After the 11th year the percentage of well-nourished children increases noticeably. The districts in which the poor classes of people live show a great predominance of only medium or badly nourished individuals.

The condition of the musculature corresponds closely to the general state of nutrition of the children.

Height. — The difference between the maximum and minimum height of children of the same age was found to be very considerable. The difference reached the maximum of 45.75 cm. Under these circumstances a boy of 10 years of age was found to reach only the average height of boys of 6 years of age, while another boy of 10 years attained the average height of a boy of 14. The average height of the boys compares thus with the height of Boston boys[2]:

Years	6	7	8	9	10	11	12	13	14
Prague boys	109.9 cm.	115.5	120.5	125.3	129.4	133.5	138.9	144.3	150.9
Boston boys	111.1 "	116.2	121.3	126.2	131.3	135.4	140.0	145.3	152.1

[1] In New York the greatest number of births occur, with considerable regularity, in August, which places the maximum number of conceptions in November. See my *Rep. on Anthropol. Work in the State Institutions for Feeble-Minded*, Syracuse (1898), p. 8.

[2] Bowditch, H. P. *Ann. Rep. of the State Board of Health of Massachusetts* (1877), p. 275.

The rate of growth of American and Bohemian boys does not differ materially, but the Bohemian boys remain throughout life between 1 and 2 cm. shorter. It is difficult to say how much of this smaller height is due to racial characters and how much to inferior nutrition. The Bohemian boy is also smaller than the English and Swedish boy, but surpasses in height the Belgian, Polish, Italian, and most German male children. The children of poor classes show much smaller average height than the children of well-to-do people. This has been equally observed on American children (Bowditch, Boas).

Weight. — The average increase in weight was not found to correspond exactly, or at all ages of the children, with the height. The weight of the boys was as follows:

Years	6	7	8	9	10	11	12	13	14
Prague	18.6 kg.	21.2	23.4	25.1	27.2	30.8	33.4	36 8	40.7
Boston (Bowditch)	20.5 "	22.5	24.5	26.9	29.6	31.8	34.9	38.5	42.9

The American boys are at all ages, but especially at 10 and from 12 years upward, the heavier. Up to the 7th year the weight of the Bohemian girls and boys was found almost alike; from 7 to 12 years the girls remain behind the boys in weight; from the 12th year, however, they begin to surpass the boys. This fact has been observed by other investigators. It signifies the approach of puberty, which in girls begins by augmented deposition of fat.

The Circumference of the Head measures show the following averages:

Years	5½	6	7	8	9	10	11	12	13	14
cm.	50.72	50.92	51.18	51.43	51.75	51.9	52.12	52.34	52.8	53.05

The average annual increase = 0.28 cm. The measures are slightly (0.5 to 1.0) smaller than those which I obtain in American-born children of same ages, which is in relation with the somewhat greater height and weight of these children.

Circumference of the Thorax. — This is a very uncertain measure. The average circumference of the thorax of the 6-year-old Prague male children was 58.7 cm.; the annual increase amounted, on the average, to 1.6 cm. The increase was least between 6 and 7, and again between 11 and 12 years; but, as it was the greatest between the years 7 and 8 and 12 and 13, the probability is that the average differences in age between the two series were greater than 12 months. The thoracic circumference of the 14-year-old boys reached 72.0 cm.

Color of Hair and Eyes. — These characters allow us to distinguish two types in Bohemia; namely, the blonde, which prevails in the north and in the more mixed districts, and the dark, which prevails in the south and throughout the more purely Bohemian districts. In Prague and other large cities considerable mixture of these two types occurs. According to all indications, the dark type is gradually gaining on the blonde. Among children the hair, which is often light in early age, as years advance, in many cases rapidly becomes darker. The color of the eyes is more stable. Red hair is exceptional (1.9 per cent). The dark type of children shows certain physical advantages over the light type, but the medium or mixed type surpasses both and has apparently the best chances of existence.

Influence of the Occupation or Social Position of Parents on the Physical Condition of the Children. — This subject is naturally very complex. The results of the investigation show that the physical development of the children corresponds (*a*) to that of the parents, and (*b*) to the kind and abundance of food and the degree of other hygienic conditions. The children of butchers and dealers in smoked meat are among the best developed; on the other hand, the children of shoemakers and those of railroad employees are among those that show most defects of development. The results indicate that the physical state of a child is partly due to heredity, partly to acquisition. Children of immigrants (from the country) are in a somewhat better physical condition than city-born children.

Morals and Abilities. — The best-developed children show the largest percentage of able children, and *vice versa*. This is in accord with the results obtained by Gracianov (Russia), Sack (Russia), Porter (St. Louis). The extremes of the blonde and the dark type show smaller proportions of able children than the middle type. The more able children show larger average circumferences of the skull than the less able. The most prevalent form of the head among the able Bohemian children is a moderate brachycephaly.

As to the relation of the morals and physical condition of the children, nothing definite can be said. The size of the head of moral children seems to be, on the average, slightly greater than that of immoral individuals.

Diseases of Childhood. — The author finds that children with light hair and light eyes, hence the blonde type, are more frequently attacked by various infectious diseases of childhood. Boys with dark eyes are attacked by measles and variola with a little more frequency than boys with blue eyes. The most favorable conditions are

again noticed among children of the mixed type. The city-born children show a slightly greater tendency to infectious diseases, except to scarlatina, than those born in the country.

The city-born children examined show 8.2 per cent of short-sighted individuals, those born in the country only 7.6 per cent. Defects of hearing were noticed in 5.4 per cent of the 7607 boys examined. These data cannot be considered in any way as very exceptional. Myopia is more frequent among the dark, defects of hearing among blonde, children.

Such are, briefly, the results of the study of Dr. Matiegka. The creditable work arouses the reflection, Why do not all our large American cities follow the example of Boston, Worcester, Toronto, St. Louis, where highly successful work of similar nature has been done? Our cities are certainly more able financially to support work of this nature than is Prague, or, in fact, any European city; and the investigations are at least more desirable and promising than in any European capital. The most interesting and instructive conditions of choice, mixture, survival, and, possibly, evolution, are passing under our eyes unrecorded. This is a country which presents almost all the climates, an infinity of social conditions, and a large number of racial relations, which all more or less affect the development of the American of the future. Yet most of these opportunities are neglected. This is only partly, if at all, due to a lack of the proper men to do the work. The main obstructions which the American anthropologist has to contend with in this particular line are a disinterested, or even unfavorable public sentiment and, what will no doubt appear incomprehensible to our European colleagues, a lack of funds.

ALES HRDLICKA.

Anthropological Notes. — In the April number of the *Geographical Journal* it is stated that letters from Mr. Low, dated December 30, have been received, telling of his arrival at Great Whale River, on the east coast of Hudson Bay. He had surveyed about five hundred miles of coast, half of which was entirely new. Mr. Low carried a pair of skis with him, and states that the Eskimos of Great Whale River are devoting themselves to making and learning to use skis.

In the same journal Mr. Edward Heawood gives a summary of the contents of a dozen recent books on Africa.

Dr. William Sorenson, of Copenhagen, we are told in a paragraph in *Natural Science* for April, has shown that Worsaae was the first to

discover the true character of kitchen-middens. "Fifty years ago it was an audacity to believe in men so very ancient as these oyster-eaters. Now we only think of their audacity in eating so many oysters."

The *Smithsonian Report* for 1897 contains an account of the archæological field work of Dr. Fewkes for that year. The primary aim of his explorations was to trace the migrations of the Hopi from the South, and to determine the limits of the Hopi and Zuni zones of ruins in Arizona and New Mexico, respectively. The greater part of the summer was spent in the Pueblo Viejo region; from the identity in color, texture, and decoration of the pottery in upper and lower Gila ruins, and the fact that in both regions the people cremated their dead, Dr. Fewkes concludes that the former inhabitants were of a similar state of culture, if not of the same stock. The distribution of the varieties of pottery is shown by maps, and its form and decoration by numerous plates.

During the excavations made at Brassempouy in 1897, by MM. E. Piette and J. de La Porterie, a number of interesting examples of prehistoric art were discovered. Especially noteworthy among these were the engravings representing the horse and other animals. To the reprint from the original paper in *l'Anthropologie*, Vol. IX, pp. 531–555, is appended a list of the numerous scientific papers by M. Piette, which extend over a period of nearly half a century.

In an entertaining paper upon the Indian Congress at Omaha, published in the *American Anthropologist* for January, 1899, Mr. James Mooney has condensed much valuable information regarding the present status of the Indians. About twenty tribes were represented at the Congress, mostly of the plains type; these are briefly described, and a table containing a few words from their languages is added.

A number of articles of anthropological interest are to be found in Vol. XII, Part III, of the *Proceedings of the American Antiquarian Society*. Edward E. Hale describes the manuscript dictionaries of the Massachusetts Indians which were bequeathed to the society by Dr. J. Hammond Trumbull. These have been placed in the hands of Albert S. Gatschet for publication by the Bureau of Ethnology. G. Stanley Hall gives an account of "Initiations into Adolescence," particularly church initiations.

G. Papillault has published a valuable paper upon the "Ontogeny and Phylogeny of the Human Cranium" in Vol. IX, No. 4, of the *Revue de l'École d'Anthropologie de Paris*.

The results of an extended and valuable anthropometrical investigation have been recently published by Dr. Ales Hrdlicka, who measured and examined the thousand white and colored children in the New York Juvenile Asylum and the hundred colored children of the New York Colored Orphan Asylum. The object of the investigation was "to learn as much as possible about the physical state of the children who are being admitted and kept in juvenile asylums. In the second place, this study is a part of the general anthropometrical work of the author, and thus expected to result in an addition to our knowledge of the normal child and of several classes of children who are, morally or otherwise, abnormal." The plan of arrangement of the records obtained will show the scope of the work. 1. General data on the total of subjects. 2. Detailed study; children in this group are separated according to their color, sexes, and ages. 3. Physical differences between white and colored children of both sexes and different ages. 4. Children of different nationalities. 5. Children without any physical defects, with their family and individual histories. 6. Children with five or more physical abnormalities. 7. Vicious and criminal children. 8. Children whose parents were intemperate, prostitute, or criminal. 9. Children both of whose parents are dead. 10. Children one or both of whose parents died of consumption.

F. R.

PSYCHOLOGY.

"The Dawn of Reason." — Dr. Weir has written an exceedingly readable book in his *Dawn of Reason*,[1] and one important for the large results it presents of personal study of the simpler forms of life, and of original research upon the nature of their sensory processes. As its chief title indicates, the aim of the work is to trace back mental traits to their origins, and to point out their earliest manifestations in the scale of animal life.

In ten chapters the author treats the Senses in the Lower Animals, to which he adds two auxiliaries, Color-change and the Homing Sense; Teleological Reactions, including Simulation of Death; Memory, Emotion, Æstheticism, and Parental Affection.

It is difficult to estimate the value of the author's results, since

[1] Weir, James Jr., M.D. *The Dawn of Reason;* or, Mental Traits in the Lower Animals. New York, Macmillan. 8vo, pp. 234.

the conditions under which they were obtained are so meagerly given. For the appraisal of such work it is of the first importance that the reader should know that the conditions of experimentation were beyond cavil, for in any scientific investigation the whole significance of the evidence may turn upon the observance of apparently slight precautions, and scarcely a hint is here given of the methods and control of conditions by the investigator. The book is throughout — if we except the detailed and patient analysis of nervous structure and sensory processes in the lower orders of life — rather observational than experimental, and the author is inclined to rely upon an interpretation of significant incidents instead of extended and systematic tests.

In regard to several of the author's conclusions criticism may be entered. Dr. Weir has made many interesting observations concerning the location and acuteness of the sensory organs in the lower animals, but when among these senses he proposes to include tinctumutation and letisimulation, I must demur. Color-change is a reaction upon a particular environment, not a perception of the nature of that environment, and is no more a sensory process than is the flight of an insect to escape the sudden leap of a toad. Sensory is contrasted with motor as perception with reaction. The color-change may depend upon a sensory stimulus as does the action of the insect escaping the toad, and the function may cease upon the extirpation of certain nerve centers, — either sensory, by which it becomes insensible to the change in the environment, or motor, by which it becomes unable to adapt itself to that change, — but it is not, therefore, more of a sensory process than is the reactive adjustment of the insect. The writer must go much farther than this to prove his point, for the establishment of a connection between motor function and nerve-center activity does not evince even the existence of an accompanying sensory process. The whole function might be a reflex form of activity without accompanying consciousness.

Dr. Weir objects to calling this function an instinctive one, but unless he should maintain that it is an adjustment empirically acquired by the individual, in thus establishing its dependence upon a sensory process he has but proved its analogy to all instincts, which are essentially perception-reactions, and differ from acquired habits only in the nature of their origin. The impulse may or may not be accompanied by awareness of its significance, but this comment in no way affects its character as an instinctive impulse.

In his treatment of letisimulation the author reduces it to the

type of the color-changing function, a perception-reaction of teleological fitness under the given environmental conditions. He conceives it throughout as a true simulation, a "device," "pretense," or feigning; but this is by no means an indisputable conclusion. It overlooks the theory that the simulation of death is a true syncope, the temporary paralysis of the nervous system being induced by sudden shock — a theory which views the process as an advantageous adaptation to the environment, but not a designed adjustment to it. This conception is apparently overlooked in the book, yet in view of the conflict of evidence, no investigator is justified in putting it aside unconsidered. Preyer regards the whole phenomenon of letisimulation in insects as due to cataplexy, and Romanes, while commenting favorably upon this opinion, cites other authorities who interpret after the same fashion the feigning of death in the higher vertebrates as well.

ROBERT MACDOUGALL.

The Methods of Comparative Psychology.[1] — In his *Dawn of Reason*, Dr. Weir's sympathetic interpretation carries him, I am inclined to think, too far in his ascription to lower orders of life of processes and methods analogous to those of human mental activity. It is possible to read too little of psychical accompaniment into the animal's actions, as in the extreme type of Cartesian automatism, and it is possible also to read too much. To illustrate with an incident at hand: A Boston lady had a pet house-dog whose favorite snoozing-place was a certain cushioned chair. If his mistress needed the chair and found him occupying it, instead of roughly ejecting him, her method was to adopt the ruse of calling him to the window by pointing to something in the street and telling him to watch, whereupon she would take possession of the coveted seat. One day, while seated in the chair herself, the dog came into the room, and after nosing about for a moment, ran to the window, gazed up and down the street and began barking excitedly. His mistress soon arose and came over to seek the cause of the dog's alarm. Unable to discover anything, she turned away toward her easy-chair again, but only to behold the little animal snugly curled upon it in oblivion and content. Reasoning from analogy between the actions of the dog and those of his mistress, one would say that he had deliberately made use of artifice to obtain possession of the seat. The only facts contributed by the incident itself, however, are the barking

[1] Mills, Wesley. The Nature of Animal Intelligence and the Methods of Investigating It, *Psychological Review*, vol. vi, No. 3, May, 1899.

at the window and the jumping upon the chair; all the rest is a comment by the observer, and the hypothesis of artifice must maintain itself by further proofs than the incident in question affords, against the supposition that the acts were independent and both of them naïve. The parsimonious view is adopted by Dr. Edward Thorndike in a monograph,[1] which Professor Mills discusses in the present article. Aside from the more special problems of Memory and Imitation in the lower animals, concerning which he is at issue with the writer of that monograph, Professor Mills takes up two questions of the first importance in comparative psychology. The first is that of the methods and conditions of experimenting; the second that of the interpretation of data.

In systematic investigations of the life of the lower animals it is often unavoidable that the subject of experimentation should be surrounded by artificial conditions, — range must be limited, dietary changed, and daily routine of acts readjusted, — but every such innovation is a fresh obstacle in the way of the sincere observer, and to introduce them wholesale, or to overlook their disturbing influence is simply to destroy the whole value of one's results. In many cases the familiarity or strangeness of the environment is the controlling element of the experience, and to fail of taking it into account is to miss the whole significance of the action. Dr. Thorndike's results come very near to being valueless if, as Professor Mills says, "This investigator has practically ignored this in his tests, for he placed cats in boxes only 20 x 15 x 12 inches, and then expected them to act naturally. As well enclose a living man in a coffin, lower him against his will into the earth, and attempt to deduce normal psychology from his conduct."

The value of Dr. Weir's observations lies very greatly in just this fact, that his book is the result of a score of years afield, where he studied the animals as he found them, living the free life of their natural habitat, and not under the inhibitions and disturbances of an artificial laboratory environment.

The second point of Professor Mills's discussion is of scarcely less importance, namely, the interpretation of the data afforded by the actions of the animals under observation. Comparative psychology labors inescapably under the disadvantage of an indirect method of observation. Here, unlike all human psychology, no experience can be reported upon by its subject. The investigator must depend

[1] Animal Intelligence. Monograph Supplement to the *Psychological Review*, vol. ii, No. 4, whole number 8.

wholly upon those secondary results of mental activity which are expressed in the form of physical changes. From these he must analogically reconstruct the set of psychical changes which it is the intention of his psychology to describe. His way is thus beset with peculiar difficulties, and every precaution must be taken to guard against false interpretation of the data. Reaction from the flagrant error of freely reading human motives and play of ideas into the actions of the lower animals must not lead us into the equally false position of assuming that the simplest explanation of such conduct must necessarily be the true one. When my dog follows me to the corner of the street and, on seeing me turn in the direction of the market square where he has been roughly used, instead of toward the college yard whither he has always followed me with delight, drops suddenly upon his haunches, watches my steps a moment, and then turns homeward, his action is to be explained in accordance with the more complex hypothesis, not with the simpler. His interest has not died out, nor has a new object attracted him. The desire to accompany me is still a living motive, but its effect is transformed into an act of the opposite nature through the more powerful motive of fear. This is but an illustration of a condition of affairs which is constantly met with, in which the advocates of the simplest explanation are wholly out of court. Inhibition plays a tremendous part as a determinant of action in the lower animals, and the deficiency of our accounts of their mental life is doubtless in part due, as Professor Mills says, to the fact that "insufficient attention has been given to distinguishing between normal, sub-normal, and super-normal comparative psychology," and especially, I may add, to the lack of an intimate study of the relation of the animal to its environment with regard to the facts of inhibition and disturbance of normal motivation.

ROBERT MACDOUGALL.

ZOÖLOGY.

Some Japanese Oligochæta. — In the course of the year 1898, three papers on "Japanese Oligochæta" appeared in the *Annotationes Zoölogicæ Japonenses*, which materially extend our knowledge of this division of Japanese fauna. In the first of these — "On a New Species of Littoral Oligochæta" (*Pontodrilus matsushimensis*)[1] — Akira Iizuka describes a new species of Pontodrilus.

[1] *Annotationes Zoölogicæ Japonenses*, vol. ii, Pt. i, pp. 21–26.

This species lives in sand along the shore of Matsushima Bay, and so has the same sort of habitat as have several other species of the same genus, which are found along the seashores of other countries.

P. matsushimensis agrees with the other Pontodrilus species known to Iizuka in most characters of generic value, as the genus is defined by Beddard in his monograph; the chief difference being in the position at which the sperm duct actually opens into the spermiducal gland. According to Beddard, the position of this opening is at the "junction of glandular and muscular parts" of the spermiducal gland, while in the Japanese species the sperm duct enters the wall of the glandular part near its junction with the muscular portion, and then traverses the wall to the other end of the glandular portion before actually communicating with its lumen. As this relation of the sperm duct to the spermiducal gland is apparent only from a study of serial sections, and as Iizuka assumed that no other species of Pontodrilus had been studied in this way, he concluded it probable that similar relations would be found to exist in the other species. The writer seems not to have been aware of the extended and careful work of Eisen[1] on *Pontodrilus michælseni*, published in 1895. Eisen's account of this species is accompanied by numerous figures made from cross-sections, and shows that the superficial entrance of the sperm duct into the spermiducal gland has nearly the same position as in the case of *P. matsushimensis*, but furnishes no evidence that the internal communication is the same. On the contrary, it would indicate that the communication of the lumen of the sperm duct with that of the gland is near the point of the superficial entrance of the duct into the gland. This condition of things in *P. michæiseni*, while it may render doubtful the correctness of Iizuka's assumption that other species of Pontodrilus will be found to have the same relation of sperm duct and spermiducal gland as exists in *P. matsushimensis*, helps to bridge over the differences between that species and the others, and so lessens the necessity for establishing a new genus to receive it.

"New or Imperfectly Known Species of Earthworms" is the title of a paper in which the authors give us the first of a series of articles which they propose to contribute on the Oligochæta of Japan.[2]

In a third paper are described sixteen new species of Perichæta, and

[1] Pacific Coast Oligochæta, I, *Mem. Cal. Acad. Sci.*, vol. ii, No. 4.

[2] Goto, S., and Hatai, S. New or Imperfectly Known Species of Earthworms, No. 1, *Annotationes Zoöl. Japonenses*, vol. ii, Pt. iii, pp. 65–78.

mention is made of one other species which they doubtfully identify with *P. sieboldi* Horst, the first Perichæta species described from Japan, and one well known in European museums. Of over two hundred specimens belonging to this species, all without exception differed from the descriptions of *P. sieboldi* by European writers in one important character, *viz.*, the position of the spermathecæ. Since many of their specimens were collected from the same region from which the European specimens were known, or supposed to have been collected, it seems to be the inference of the authors that their species is identical with *P. sieboldi*, and that the European writers erred in their description of that species. Unfortunately their own description is so extremely meager that it is of little use to any one else who might attempt to determine the relations of their species to others already described.

Horst,[1] who first described *P. sieboldi*, has reëxamined the type of that species and confirmed the correctness of the earlier descriptions, and concludes that the two species are not identical.

The genus Perichæta already includes a hundred or more species, and the need is great for more detailed descriptions than those which our authors have seen fit to give us.

Horst calls attention to the peculiar fact that of the nine species of Perichæta previously described from Japan, none have come under the observation of Goto and Hatai.

In a third paper[2] is described a species living in the gutters and ditches of Tokyo, and belonging to the family Tubificidæ. These worms seemed to the author to be more nearly allied to *Vermiculus pilosus*, described from the southern coasts of England by Goodrich in 1892, than to any other form, and so are included in the same genus under the name *V. limosus*.

The description is reasonably complete and includes eight pages of text, accompanied by five diagrammatic figures.

Among the more noticeable peculiarities of the new species are the short, nearly straight sperm ducts which open into a common ventral spermiducal chamber on the eleventh somite, and the unpaired opening of the spermathecæ on the ventral side of somite X, both of which characters it has in common with the other member of the genus. Some peculiarities in which it differs from *V. pilosus* are the

[1] Horst. On *Perichæta sieboldi*, *Notes from the Leyden Museum*, vol. xx, pp. 240–242.

[2] Hatai, S. On *Vermiculus limosus*, a New Species of Aquatic Oligochæta, *Annotationes Zoöl. Japonenses*, vol. ii. Pt. iv, pp. 103–111.

single sperm sac, which is evaginated from the anterior septum of somite X into the ninth somite, from which it extends backward to the twelfth or thirteenth somite; and the ovisac, which extends backward from the twelfth somite instead of from the eleventh, as is more usually the case.

Hatai has experienced the difficulties so common in the preparation of purely technical papers of eliminating errors from the text, and we find the ovaries described as being located in somite X, while they are figured in somite XI. The latter position is undoubtedly the correct one; again, the sperm ducts are described as having the funnels in the ninth somite, while the main parts of the ducts are in the tenth somite, on the ventral side of which they open to the exterior. In the figure, which is more probably correct, they are represented as being situated one somite farther back. It is stated that there is a pair of ovisacs in the thirteenth somite, "formed by the backward bulging out, on the left dorsal side, of the anterior septum." As elsewhere in the text, reference is made in each case to "the ovisac," and as it seems improbable that both members of the pair should arise on the same side of the worm, it seems more reasonable to suppose that there is but one ovisac. F. SMITH.

Strange Protoplasmic Budding in Epithelial Cells. — Every specialist is familiar with the occurrence of various vesicles and drop-like extrusions that may be found upon preserved epithelium, as if excreted. The formation of such "artefacts" has not been studied. Recently Martin Heidenhain, in the *Archiv. f. Mik. Anatomie*, Vol. LIV, pp. 59–67, has, however, described and figured peculiar finger-like protrusions from the cells of the epithelium of the uterus of a pregnant rabbit, and interpreted them as the first stages in the making of such "artefacts."

The material was hardened in corrosive sublimate, and the author conceives that this penetrating in molecular dilution acted as a stimulus to call forth a physiological, though pathological, response in the form of those protoplasmic protrusions, or pseudopodia.

How these protuberances later form the real artefacts, the vesicles, etc., that lie free from the cells, is not considered, since the chief thesis is that peculiar dark-staining bodies in each protuberance are centrosomes. The author advances much in favor of this view, and we seem to have here another case where motion of the protoplasm, in rising up to make protrusions of the surface matter, is localized about staining centers, or "centrosomes." E. A. A.

Catalogue of the British Columbia Provincial Museum.[1] — It includes mammals, birds, fishes, insects, trees, plants, fossils, ethnological specimens, etc. The distribution of the species of mammals, as well as the source of the museum specimen, is given. A full check list of the birds of the province bears a special check mark opposite those lacking in the collection, in order that the friends of the museum may know what is most acceptable. Very little is yet known of the birds of the northern and eastern parts of British Columbia. The eggs are listed, but the study-series of bird-skins, which are available to all students, is not published in the catalogue.

The ethnological collection is classified under several heads, as houses, dress, ceremony, craniology, etc. The introduction to this list differentiates the Indians of British Columbia from those of the Plains, and cautions one against drawing hasty conclusions of Japanese affinities or origin.

HARLAN I. SMITH.

The Systematic Position of Peripatus. — Since the discovery by Moseley of tracheæ in Peripatus, over twenty years ago, scarcely a doubt has been thrown upon the arthropod nature of this interesting animal. Recently[2] Boas, one of the most accurate students of the arthropods, has taken up the question of the affinities of the form in question, and after a careful consideration of its structure decides that it has nothing decidedly arthropodan in its make-up, but that in all deciding points it is clearly an annelid modified for a terrestrial life. It lacks the thick jointed cuticle characteristic of the arthropod, and its appendages are not arthropodan. It possesses the external circular layer of muscles which is not found in any true arthropod, and all of its muscles are of the smooth variety. The eyes are upon the annelidan type; the nephridia are numerous; the characteristic arthropodan hairs are lacking, while the claws, upon which so much weight has been placed, are built upon a different plan, being solid rather than hollow outgrowths.

A few points need more space. The jaws of Peripatus are modified appendages, according to both von Kennel and Sedgwick. Boas, however, points out that this jaw is but the terminal claw of Peripatus and is not the whole limb. He also calls attention to the relations of the parapodia to the mouth in the polynoid worms. The heart, like that of arthropods and unlike that of the annelid, is pro-

[1] *A Preliminary Catalogue of the Collections of Natural History and Ethnology in the Provincial Museum, Victoria, British Columbia*, 1898, p. 196, is being issued.

[2] *Kgl. danske Vidensk. Selsk. Forhandlingar*, 1898, No. 6 (1899).

vided with ostia and is placed in a pericardial sinus, but the ostia in Peripatus can be explained by the disappearance of the transverse vessels, while the pericardium is merely a blood sinus, the result of the atrophy of true circulatory tubes, these having degenerated as a consequence of the development of tracheæ. In regard to tracheæ, Boas points out that tracheæ of different kinds can exist, and that it has yet to be proved that those of Peripatus and those of the "Tracheata" are homologous; with the bulk of the evidence against the view. It is further emphasized that if Peripatus be a stem form for the "Tracheates," then, of necessity, the Arthropoda must form a polyphyletic group — in other words, the Arthropoda must go, for we cannot conceive how the Crustacea could have descended from insectan or myriapod ancestors. In this connection, see this journal, Vol. XXVIII, p. 230, 1894, and *Natural Science*, Vol. X, pp. 97 ff., 1897.

New York Amphibia.[1] — The Linnæan Society of New York has been issuing a series of bulletins on the local fauna of the surroundings of New York City. This work is one strongly to be commended. The *Naturalist* believes thoroughly in the importance of the study of local faunas. The present list describes 11 species: 1 Bufo, 1 Scaphiopus, 4 Hyladæ, and 5 Rana. Statements are also made concerning distribution, habitat, note, and egg-laying habits. The pamphlet will be valuable to teachers of zoölogy, as well as to investigators.

Adaptive Modifications in Respiratory Organs of the water-inhabiting mammals, especially the cetaceans, in response to their changed environment, have been investigated by O. Müller.[2] In most pronounced cases the trunk of the animal assumes the form of a spindle to accelerate movement through the water. The thorax is somewhat flattened dorso-ventrally, and the lungs, in which the lobes have been lost by fusion, are more extensively developed dorsally than ventrally. This is especially well seen in the bronchial branches, which, instead of being exclusively ventral, are often dorsal. The thoracic muscles are strong. The trachea is provided with complete cartilage rings instead of incomplete ones, as in most mammals, and the shortening

[1] Sherwood, W. L. The Frogs and Toads Found in the Vicinity of New York City, *Proc. Linn. Soc., New York*, No. 10, 27 pp., 1898.

[2] Müller, O. Untersuchungen über die Veränderungen, welche die Respirationsorgane der Säugetiere durch die Anpassung an das Leben im Wasser erlitten haben, *Jena. Zeitschr.*, Bd. xxxii, pp. 95–230, Taf. iii–vi, 1898.

of the neck often induces a fusion of ring with ring. The cartilage support for the bronchial tubes may be in the form of a spiral band, traceable well into the substance of the lung. Most of these adaptations are obviously means for resisting the enormous pressure of the water on the gas-filled cavities of the lungs, etc.

G. H. P.

Reptiles of North America. — Under the title of *Contributions to North American Herpetology*, Mr. Robert Baird McLain, of Wheeling, W. Va., has published privately three memoirs on the collections of reptiles in the Museum of Stanford University. They are entitled "Contributions to Neo-tropical Herpetology," "Notes on a Collection of Reptiles made by C. J. Pierson at Fort Smith, Kansas," and "Critical Notes on a Collection of Reptiles from the Western Coast of the United States." All bear the date of February, 1899.

These papers are full of misprints; the form of statement is often crude, and the references to other authors, as Professor Cope and Dr. Van Denburgh, are characterized by the sweeping severity which extreme youth frequently displays towards the masters.

It might fairly be inferred from the nature of their contents that these papers had received the criticism and approval of the instructors of Stanford University. It is well to state, therefore, that they represent merely the laboratory notes of an undergraduate student who had free access to the museum shelves. That publication of these notes was contemplated was not learned until after Mr. McLain had left the institution, and their appearance in print is contrary to the advice of the officers of the museum, and despite their protest. One new species *Thamnophis steinegeri* (misprinted *rteinegeri*) is described and well figured. As the material has not yet been critically studied, the value of the species is yet to be determined.

D. S. J.

Zoölogical Notes. — Dr. Oscar Loew, who has recently been called to the Department of Agriculture at Washington, has just published at Munich a timely and valuable book of some 175 pages, entitled *Die chemische Energie der lebenden Zellen.*

"Movement of the Nervous Elements" (*Act. Soc. Scient. Chili*, Tome VIII, pp. 71–76) is the title of a critical review by Daniel Monfallet, of the more recently discovered facts and their bearings on the theories of Rabl-Ruckhard, Tanzi, and Ramon y Cajal, as to

the interaction of the nervous elements. The author concludes that our present knowledge on this subject is too scanty to afford any sound basis for generalizations.

The fourth number of Volume II of the *American Journal of Physiology* contains the following papers: "The Mechanism of the Motor Reactions of Paramecium," by H. S. Jennings; "On Absorption from the Peritoneal Cavity," by L. B. Mendel; "The Origin of the 'Traube' Waves," by H. C. Wood, Jr.; "Laws of Chemotaxis in Paramecium," by H. S. Jennings; and "The Chemistry of the Melanins," by W. Jones.

The hearts of several species of lungless salamanders were studied several years ago by Hopkins, who reported the absence of pulmonary veins, but the presence of an auricular septum. H. L. Bruner (*Anat. Anzeiger*, Bd. XV, No 22) has reinvestigated the subject, and finds no auricular septum present, but that the sinu-atrial valve is so placed as to be easily mistaken for such a septum, an error which he believes Hopkins to have fallen into.

Dr. Carlgren thinks (*Zool. Anz.*, Vol. XXII, p. 102) that the *Branchiocerianthus urceolus*, recently described by Mark, is a hydroid near Corymorpha.

Walter May contributes an excellent review of the classification and distribution of the Alcyonoid polyps to the *Jenaische Zeitschrift*, Bd. XXXIII. Many new species are described.

In his "Revision of the Squirrels of Mexico and Central America" (*Proc. Wash. Acad. Sci.*, Vol. I, pp. 15–106), Nelson recognizes forty-three species and subspecies.

"North American Fauna No. 14," issued by the *Biological Survey of the United States Department of Agriculture*, contains an account of the Natural History of the Tres Marias Islands, situated in the Pacific Ocean, not far from the Mexican coast. The mammals, birds, reptiles, crustaceans, and plants are dealt with, and the report concludes with a bibliography of these islands.

Cyathocephalus truncatus is the only known cestode characterized by the transformation of the entire scolex into a single bothrium. To this genus Riggenbach has just added a second species, *C. catinatus*, from *Solea vulgaris*.

Scolex abnormalities are very common in *Cœnurus serialis*, according to Railliet, *C. R. Soc. de Biol.*, Jan. 21, 1899, who found in a

single bladder, containing 246 scolices, only 217 normal. The abnormalities are grouped as follows: (1) simple diminution in the number of suckers, two heads having three each; (2) simple augmentation in the number, two heads having five suckers each, six, six each, one eight and one nine suckers; (3) double rostellum, two heads with two rostella each; (4) double rostellum with extra suckers also, two scolices with double rostella and six suckers each, one such with nine and one with ten suckers. If it be true that the heads with six suckers produce the triangular chains in the adult, as has been generally maintained, the author justly inquires what heads with three, five, eight, nine, and ten suckers will produce?

In a seal shot during the Swedish Arctic Expedition of 1898 were found abundant remains of a cephalopod, identified by Lönnberg (*Ofversigt, Kgl. Vet. Akad. Förh.*, 1898, No. 10, p. 791) as *Gonatus fabricii*. This demonstration of the use of cephalopods as food by the seal in its pelagic wanderings shows "that the cephalopods form an important link in the chain of marine organisms from the microscopic plankton to the mammals."

NEWS.

SIR WILLIAM TURNER, of Edinburgh, has been elected president of the British Association for the Advancement of Science for the meeting of 1900.

Dr. E. V. Wilcox has resigned the chair of zoölogy in the University of Montana and will accept a place in the Agricultural Department at Washington, where he will have charge of the zoölogical items in the *Experiment Station Record*, a position left vacant by the resignation of Dr. F. C. Kenyon.

The Scientific Alliance of New York now includes eight societies, with a total of over 1100 members. It has a research fund of $1200 and $10,000 towards the erection of a building for the accommodation of the constituent societies.

Dr. John W. Harshberger, instructor in botany in the University of Pennsylvania, invites subscriptions to his work, *The Botanists of Philadelphia and their Work*. The manuscript is complete and awaits subscriptions sufficient to make its publication possible.

The State University of Ohio maintains a lakeside laboratory this summer at Sandusky, Ohio. The laboratory is intended exclusively for investigation and no instruction is given. The station is under direction of Professor Herbert Osborn of the university.

A bronze bust of the late Increase A. Lapham was unveiled in the Public Museum of Milwaukee, March 7.

Dr. L. L. Hubbard has resigned his position as state geologist of Michigan.

The University of Nebraska receives $496,000 for the next two years, $93,000 of this being for buildings and improvements.

The University of Chicago has made the following appointments to fellowships for the ensuing year: Botany, A. C. Moore, B. E. Livingstone, S. M. Coulter, F. M. Lyon; Zoölogy, H. E. Davies, R. S. Lillie, F. M. Guyer, H. H. Newman; Neurology, D. M. Shoemaker; Physiology, R. R. Rogers, W. E. Garvey; R. W. Webster; Anthropology, A. W. Dunn; Geology, W. W. Atwood, W. N. Logan, R. George, W. T. Lee, W. G. Tight.

An index to the first thirty volumes of the *Jenaische Zeitschrift für Naturwissenschaft* has just been issued. A few months ago a similar index to Vols. XLI–LX of the *Zeitschrift für wissenschaftliche Zoologie* was published. Both indices are very complete and detailed.

Dr. F. W. C. Areschoug, for many years professor of botany in the University of Lund, Sweden, has resigned.

Professor Douglas Houghton Campbell, of Leland Stanford University, will spend the coming year in Europe, on leave of absence.

The next meeting of the American Society of Naturalists will be held at New Haven, Conn. Most of the affiliated societies have signified their intention of meeting at the same place.

Appointments: Marshall A. Barber, assistant professor of bacteriology in the University of Kansas. — Mr. Joseph Bancroft, a physiologist, fellow of King's College, Cambridge. — Dr. Bergen, professor of geology and mineralogy in the Mining School at Klausthal. — W. J. Blankinship, professor of botany in the Agricultural College of Montana. — Dr. W. von Branco, of Hohenheim, professor of geology and paleontology in the University of Berlin. — I. H. Burkill, assistant to the director of the Kew Gardens. — Dr. Calmette, professor of bacteriology in the medical faculty at Lille, France. — Dr. Otto Cohnheim, privat-docent for physiology in the University of Heidelberg. — Dr. Dove, professor of botany in the University of Jena. — Dr. Erich von Drygalski, professor of geography in the University of Berlin. — J. Dybowski, of Paris, director of the newly established Colonial Gardens at Vincennes, France. — Dr. Eggeling, privat-docent for comparative anatomy and embryology in the University of Strassburg. — Dr. Ferdinand Filarsky, custodian of the botanical section of the Hungarian National Museum at Budapest. — Dr. Hugo Fischer, privat-docent for botany in the University of Bonn. — Dr. Jakob Früh, professor of geography in the Zürich Polytechnicum. — Mr. E. E. Green, entomologist of the agricultural department of Ceylon, with headquarters at Peradeniya. — Dr. A. Y. Grevillius, assistant in botany in the Kempen (Germany) Agricultural Experiment Station. — Dr. David Frazer Harris, tutor in physiology in the University of St. Andrews, Scotland. — A. L. van Hasselt, professor of ethnology in the Indian Institute at Delft, Holland. — Dr. Curt Hassert, professor of geography in the University of Tübingen. — W. Botting Hemsley, director of the Kew Herbarium. — Dr. Anton Herrmann, privat-docent for anthropology in the University of Klausenberg,

Austria. — Dr. Moritz Hoemes, professor extraordinarius of prehistoric archæology in the University of Vienna. — Samuel J. Hunter, associate professor of entomology in the University of Kansas. — Dr. Georg Karsten, professor extraordinarius of botany in the University of Bonn. — Dr. Gustaf Adolf Koch, professor of geology in the Vienna Agricultural School. — Dr. Albert Krafft von Dellmensingen, of Vienna, assistant on the Geological Survey of India. — Dr. Maria, Countess von Linden, assistant in zoölogy in the University of Bonn. — Edward Alfred Minchin, of Oxford, tutor of biology in Guy's Hospital Medical School, London. — Dr. F. S. Monticelli, of Cagliari, professor of zoölogy in the University of Modena. — W. A. Murrill, assistant in cryptogamic botany in the Cornell Experiment Station. — Dr. W. Petterson, lector for mineralogy and geology in the Stockholm Technical School. — Dr. Frederico Raffaele, professor extraordinarius of zoölogy and comparative anatomy in the University of Palermo. — Dr. Fritz Regel, of Jena, professor extraordinarius of geography in the University of Würzburg. — Daniel E. Rosa, of Turin, associate professor of comparative anatomy in the University of Sassari. — Dr. Achille Russo, of Benevento, professor of zoölogy and comparative anatomy in the University of Cagliari. — Frederico Sacco, professor extraordinarius of paleontology in the engineering school at Turin. — Dr. Solomon, professor extraordinarius of mineralogy in the University of Heidelberg. — W. C. Stevens, professor of botany in the University of Kansas. — Professor J. Arthur Thompson, regius professor of natural history in the University of Aberdeen. — Professor A. E. Törnebohm, chief of the Swedish Geological Survey. — Swale Vincent, first assistant in the physiological laboratory of the University of Cambridge. — Professor F. L. Washburn, state biologist of Washington. — Dr. Engen Ph. Wotczall, professor of botany in the newly established technical school at Kieff, Russia. — Dr. Wilhelm Zopf, professor of botany in the academy at Münster, Germany.

Deaths: J. Hermann Albarda, ornithologist, in Leenwarden, Holland. — Theodor Beling, student of Diptera, in Seesen Brunswick, Germany, December 17. — Konstantin Busiakis, professor of physiology in the University of Athens. — Wilhelm Dames, professor of geology and paleontology in the University of Berlin, December 22, aged 55. — P. Alfred Feuilleaubois, fungologist, at Fontainebleau, France. — Charles Fortunn, mineralogist, in London. — Dr. Leopold Tausch von Glöckelsthurn, of the Austrian Geological Survey, January 2,

aged 40. — Dr. Gruby, a student of poisonous fungi, in Paris. — K. G. Henke, conservator of the zoölogical and ethnographical museum at Dresden, February 18, aged 68. — Friedrich Jeppe, geologist, in the Transvaal, August, 1898. — Dr. Heinrich Kiepert, professor of geography in the University of Berlin, April 21, aged 79. — Major Krüger-Velthusen, ornithologist, in Berlin, November 26. — Dr. Oliver Marcy, professor of natural history in Northwestern University, at Evanston, Ill., March 19, aged 79. — Alfred Paul Maupin, student of Coleoptera, in Paris, January 22. — M. Naudin, French botanist, aged 83. — William Burges Preyer, the well-known student of Lepidoptera, for twenty years settled in Borneo, at Port Said, Jan. 7, 1899, aged 55. — Joseph Stevens, geologist, April 7, aged 81. — Dr. Philipp J. J. Valente, a student of Central American archæology, in New York, March 16, aged 71. — Adolf Walter, ornithologist, at Kassel, Germany, February 5. — Aulis Westerlund, student of Hymenoptera, in Finland, December 7. — Paul Wladimirowitsch Jeremejew, formerly professor of mineralogy in the mining school at St. Petersburg, January 18, aged 68.

PUBLICATIONS RECEIVED.

(The regular Exchanges of the *American Naturalist* are not included.)

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